SCIENTIFIC AMERICAN

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THE PARK AVENUE IMPROVEMENT IN NEW YORK CITY—THE TEMPORARY HARLEM RIVER BRIDGE AND THE MOVING OF THE MOTT HAVEN STATION.

We have recently illustrated some of the operations which are now in course of execution for the Park Avenue improvement in New York City. As we stated in the article referred to, which appeared in our issue of April 28, there is included in these changes the erection of a new bridge over the Harlem River, to replace the present one. In order to give the railroad transit across the river while the new bridge is in course of erection, a temporary drawbridge and viaduct has been built, crossing the river to the west and north of the old one. The temporary tracks diverge from the present line some distance south of the Harlem River and return again to the existing line north of the river in Mott Haven. Some years ago, when the necessity for an auxiliary drawbridge in the then existing bridge over the Harlem became apparent, which necessity was brought about by the liability to injury of the rotary draw in regular use, a tower lift drawbridge was added purely as an auxiliary. This gave an opening of 50 feet span, available in emergencies, and consequently was but little used. Eighteen months ago, after the present improvements had been arranged, it was decided to utilize the tower of this draw for the temporary bridge, moving it to the new line and adding thereto a new lift span, so as to supply a drawbridge in connection with the viaduct. The operation of moving the tower was described in our issue of December 31,

(Continued on p. 296.)

THE PARK AVENUE IMPROVEMENT IN NEW YORK CITY—MOVING THE MOTT HAVEN STATION.

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THE RICH AND THE POOR.

During the last few weeks our country has been the scene of a series of pilgrimages, all directed to the shrine of the Federal capitol, and having for their object some mysterious alleviation by governmental methods of the hardships of the poor man's life. The central idea underlying these organizations seems to be that as money is the embodiment of man's possessions and opens up to him the road to happiness on earth, and as the government possesses the right to coin money in its mints and print bills in its printing offices, that it also can be for the nonce the creator of money. The members of these pilgrimages, termed Coxey's Army, Kelly's Army and the like, propose to go to Washington, and by their presence to give so imposing a demonstration as to influence legislation in the desired direction. One scheme is to have the government issue bonds, bearing no interest and payable in installments.

Whatever one's opinion may be of the right of a man to be rich, it is far from clear how the proposed issue of bonds could be conducted so as to produce any good effect. As the world is organized and as humanity is constituted, there will always be rich and poor. The distribution of wealth may seem unjust. The deserving inventor who has worn his life out in devising improvements in mechanical things, the scientist who has worked for hours evolving in the laboratory new chemical products, the bacteriologist who finds a panacea for the most dreaded diseases, certainly rank as the benefactors of humanity; but the history of the world shows that it is precisely these classes who receive the benefit least commensurate with the value of their work, when its importance to the rest of humanity is considered. The inventor invents and patents and the capitalist makes the fortune from the invention. This is the story repeated over and over again. Yet unjust and severe as it seems, this is the definite lot of humanity, and there is no probability that the cure of inequality of fortune will ever be discovered.

The typical inventor invents because he has to, and he may hope to reap a modest reward from his work. Whether he does or does not, his very genius will not allow him to be idle. The apparent injustice has to be endured. But in spite of the communistic tendencies of the age on one side, and of the undue accumulation of wealth by the few on the other side, examples sometimes appear where the benefactor of humanity from the standpoint of scientific or mechanical advancement meets with an adequate reward. In a recent address before the old New York society, the General Society of Mechanics and Tradesmen, Mr. Abram S. Hewitt, well known from his prominence in the iron industry, as well as from his political record, gave a most graphic presentation of the results of the work of one of the world's greatest benefactors, Bessemer. We quote from the concluding portions of his address:

"You all know about the Bessemer invention of steel. It was made in 1855 by a student in his laboratory. He propounded his idea to the world, but it took fifteen years before it was successfully put in operation. I know Mr Bessemer very well. He is a modest man who never sought to make a fortune, but he has taken the rewards of his great invention, and he told me the last time I saw him in London that he had got out of his invention £2,000,000—nearly $10,000,000. The contribution which he made to the world by that invention in the saving it has effected in the ordinary operations of society is simply incalculable. If I were to say we were saving $1,000,000,000 a year in this country alone as the result of that invention applied to every branch of industry, particularly in the transportation of the goods and the products of the country, I should certainly underestimate the amount. And now I am going to say something even more surprising. Taking the world together, the saving effected by that invention is greater than the total value of all the movable capital of the world one hundred years ago.

"One man, by a single invention, has contributed to the aggregate wealth of the world more value than existed fifty years before his birth. Now he has got ten millions of dollars. It is a great sum. He will leave it to his children, who have done nothing, have contributed nothing to the acquisition of this money. Whom has he robbed? Whom will his children rob? Who would be the gainer if he had never received one penny for his great discovery? How much would the distribution of his $10,000 000 over the face of society add to the fortune of any single individual, and how much has his invention added to the fortunes of all mankind?"

Waterproofing Fabrics.

According to Holfert's process for waterproofing fabrics, the materials are first passed through a bath of gelatine, then exposed to the action of formaldehyde in a gaseous state. The gelatine is thus rendered insoluble and imparts water-resisting properties to the fabrics.

Pipe Lifting by Expansion.

An interesting illustration, to be commended to the notice of popular lecturers, of the old aphorism that "knowledge is power," as well as of the more modern definition of science as "organized common sense in regard to things," is supplied by some recent proceedings of Mr. Howe, the engineer of the Clay Cross Collieries. It is reported that some weeks ago the second pipe from the bottom of a 6½ inch rising pump main, 140 yards long and 30 tons in weight, in one of the Clay Cross pit shafts, broke off at the branch connecting it with the underground pumping engine. The whole weight of the line of piping rested upon itself, so that it was a question of how to get the broken member out and replace it. Mr. Howe decided, with the concurrence of Mr. Jackson, the manager, to lift the pipe column by the force of expansion due to steam heat. Accordingly, a cross beam was inserted in the shaft at a height of 60 yards from the bottom, bearing close against the defective main, and not far under one of the flange joints. The pipe being then empty, steam was turned into it at the bottom through a ½ inch pipe and regulating cock; and in the course of an hour the main had moved up 2½ inches at the point where the cross beam was fixed. The main was then secured to the beam by strong clamps, and as soon as the weight had been taken in this way, steam was shut off; and the pipes, contracting, began to lift the broken end from the pit bottom. The broken pipe was changed for a sound one, and steam again turned on until the clamps could be taken off. The time occupied in the operation, from first turning on the steam to restarting the pumps, was only four hours; and the operation was effected without a hitch.

Dr. Brown-Sequard's Orchitic Fluid.

The death of Dr. Brown-Sequard has served to revive in some minds an interest in his orchitic fluid, in which the great physician had himself much hope.

The *Lancet* in a recent number publishes some significant notes upon experiments with the fluid made by Dr. Guy M. Wood and Dr. A. J. Whiting, both physicians to the Hospital for the Paralyzed and Epileptic, Queen's Square, London.

The fluid used was obtained directly from Paris, through Dr. Brown-Sequard's personal kindness. The injections were hypodermic, made with a Koch's syringe, kept aseptic in absolute alcohol. The dose was from one gramme of the fluid to six grammes, and in all but three cases, diluted with an equal quantity of water. Except when the doses were large, no immediate effects were perceptible. In those cases some pain was felt at the point of injection.

Twenty-three patients were treated. In eighteen cases there was no change from the treatment; three patients were slightly better; two were worse.

At the beginning of the observations several patients said they felt better after the injections. At the suggestion of Dr. Buzzard, two women were given daily injections of two grammes of *distilled water only*, for three weeks. Both the patients declared that they *felt* decidedly better after each treatment, though of course there was no change in the physical condition.

The physicians, therefore, conclude that in all the cases treated, the sensation of being better was due to the mental effect of the injection and not to the orchitic fluid, and they do not think that the results obtained warrant any further trial of the remedy.

J. O. Davidson.

In the death of Julian Oliver Davidson, the art and publishing world has sustained a severe loss. Born in Cumberland, Maryland, in 1853, he early exhibited a talent for drawing, especially of marine and battle scenes. His pictures were characterized by life and spirit, and as an artist he soon rose into prominence. As an illustrator he was well known; he worked for the leading magazines and weekly papers. For many years Mr. Davidson designed marine views for the SCIENTIFIC AMERICAN, the last occasion being views of the Vigilant and Valkyrie, published in the issue of October 14, 1893. Mr. Davidson died at his Nyack (N. Y.) home on April 30, after an illness of several months.

Peroxide Bleaching.

This is the invention of Konigswarter & Ebell, who recommended the process for the bleaching of straw, wood, and similar fibers. To 100 liters of soft, cold water, 1,600 grammes of pure crystallized oxalic acid are added, and then 1,000 grammes of peroxide of sodium are slowly stirred in. The liquor, when this is done, will still be acid, and must be made feebly alkaline with silicate of soda or with more peroxide. The stuff to be bleached must be clean and free from grease, and is put into the alkaline bath of the mixture and kept in it until bleached at a temperature of from 90 deg. to 100 deg. F. It is then rinsed and freed from any traces of yellow in a weak acid bath, tartaric, for instance, or by slow drying in the open air. The above bath can be used over and over again, and to save time may be made stronger. An economy may also be effected by substituting sulphuric for oxalic acid.

The Role of Microbes in Society.

The *Revue Scientifique* publishes an address upon this subject, before the Society of Anthropology, in Paris, by M. L. Capitan.

Quoting from an address before the same society by the distinguished scientist Broca, he speaks of the gradual overcrowding of our planet, and of death as necessary to make room for coming generations. After showing that the decomposition of dead matter is also necessary to this preparation for new life, and that the process is the work of microbes, M. Capitan thus continues: "Microbes have an important role in digestion. Ordinary digestion takes place in the stomach and intestines by means of soluble ferments secreted by organic cells, which attack the foods, separate them, and make them fit to be assimilated; it is work similar to that of microbes. But the digestive tract contains great quantities of microbes constantly brought in by food. They multiply indefinitely, and play most complex roles. They necessarily take part in the digestive phenomena, as aids in the breaking up of organic compounds, and, again, they are the *only* effective agents to that end. M. Duclaux, insisting upon this point, says that certain kinds of cellulose can be attacked by microbes only; no organic juices have that power. M. Pasteur cannot conceive of the possibility of digestion where microbes do not exist.

The purely chemical work of the microbe is enormous. What we know about it is nothing in comparison with what it must be. Every kind of microbe, every race, every variety, is charged with a special function; the division of labor is pushed to the extreme limits, so that for any chemical reaction whatever to be realized, the microbe makes several attacks. Each variety takes part in the work, beginning a partial separation of the matter, which is completed by another kind, and this goes on until the organic matter is reduced to its elementary constituents, or to a state of sufficient simplicity for the plant to assimilate it. . . .

Further, as old as the world, contemporary with the first generations of vegetables, the microbes have contributed materially to the constitution and formation of the geological strata. Microbes made the peat which later became coal; they had their part in the complex work of precipitation which made the great beds of calcareous deposits; they played their part in the complex reactions which resulted in the deposits of sulphur, iron and many of the other metals. . . .

Industrially, the chemical work of microbes is often utilized by man. Two typical examples may be given. First in the preparation of indigo. It is obtained from a wood cultivated in India, Japan and Central America. This plant contains a sugar, *indiglucine*, which is removed by washing with warm water; this *indiglucine* is then submitted to special fermentation. The microbe separates it into indigotine and sucrose. The indigotine, which is white, is oxidized by the reaction due to the microbe, and is changed into indigo, with its blue color. And this preparation would be impossible without these peculiar reactions produced by microbes.

Again, the chemical action of microbes is illustrated in the preparation of opium to smoke. . . . But it is especially in the preparation of many of the most indispensable foods that certain *micro-organisms*, thus domesticated (*i. e.*, in the preparation. Tran.), show themselves incomparable chemists. Without them these different preparations would be impossible. Such is the case with bread, alcohol, wine, beer, the different milk ferments (koumiss, kephyr), cheese, sour-krout, etc.

I cannot show you in detail the part which the *micro-organisms* have in the elaboration of each of these products. Besides, you all know what characterizes bread. Yeast is the principal agent in the fermentation. There are milk ferments, and many other kinds of microbes. For alcohol, wine, and beer there are the different kinds of yeast, with the addition of various microbes and their numerous diastases, which, as the case may be, separate the molecules of starch and change them progressively, by successive separations, into dextrine, glucose and finally into alcohol; or again, change sugar into alcohol, or even, separating from the malt, make alcohol, and finally make the complex products, wine, brandy, and beer. . . . I have spoken thus at length about microbes and I have not yet presented them to you. They are, as you know, very inferior *algæ* formed of one cell, generally with an envelope. They live almost everywhere upon and in living creatures, in the soil, water, upon solids, etc., multiplying with extreme rapidity. They have very varied actions, often useful, as you have seen, or, on the contrary, hurtful, as you will soon see.

Sometimes they take a rounded form, are little spheres with a diameter of about a half thousandth of a millimeter. Sometimes they are isolated, and, again, they are in strings composed of a more or less considerable number of grains. They may present themselves in the form of little sticks from a half to one or two thousandths of a millimeter in diameter with a very variable length, thus forming, sometimes, short sticks (tuberculose), sometimes long threads (charcoal *en culture*). The little sticks are immovable, or, on the contrary, movable, rigid or curved. They may take the form of a half circle, as in the cholera microbe, or they may present themselves in a spiral form, as the microbes of intermittent fever.

They generally color easily with the aniline colors. Finally, when they are placed in a medium suitable for their culture, such as bouillon, peptonized gelatine or solidified blood serum, they multiply in great abundance. These elementary facts give you a general idea of the morphology and biology of microbes. You know them now. I have shown you how they may be useful in society. Now let us see how they are harmful.

If microbes decompose dead matter, they may also decompose living matter! Certain kinds especially have the power which is called *virulence*. They are called *pathogenes*, that is to say, they may determine the diseases. Every kind of microbe, moreover, produces a special kind of disease and has a power which varies much, according to a number of circumstances.

But the microbe cannot *alone* make the disease; the intervention of the organism of the subject in whom the disease is to develop is necessary. If you please, following the forcible comparison of Professor Bouchard, the organism is a stronghold, the microbe is the assailant, the struggle between the two is the infectious disease.

Thus the condition of the organic domain, which the microbe seeks to invade, is important. In fact, if the person is very well, he offers a great resistance to microbes. If, on the contrary, his health is not perfect, it is a stronghold poorly defended, and the danger is great for him. For, as M. Bouchard has said for a long time, a person does not become ill, except when he is already not in very good health. But there are many means for getting into bad health. One may change his health by a number of processes, which may be summed up, essentially, in two grand classes: Troubles of organic functions and disorders of tissues. Many of the processes leading to the production and development of disease are directly dependent upon various social influences. Do you wish some examples?

Wealth, like poverty, is a powerful agent in disease. The rich man, from his frequent overeating, his want of exercise, his excess of comfort, easily acquires obesity, the gout or diabetes; his kidneys, his heart, are frequently affected. The poor man, on the other hand, from want in its different forms, from overwork, exposure to inclement weather, or want of cleanliness, may suffer from various derangements of the internal organs, the lungs, the liver, the kidneys, the bowels, etc. He has, like the rich man, a special pathology in certain points and very different from the last; a pathology, moreover, due absolutely to his social condition.

The occupations create also special diseases. They may poison those who engage in them. Lead produces chronic poisoning among those who handle it (painters, printers, manufacturers of white lead); it is the same with mercury (silverers of looking glasses, gilders, hatters). Every poison produces its special effect upon the system: lead upon the kidneys, the intestines, the brain, and mercury upon the brain and the nerves. These examples might be multiplied; they show the occupation may affect the organs, create actual diseases, or induce such a state of health as to facilitate the invasion of the microbe. Is it necessary to mention that dreadful form of poisoning, alcoholism, which produces its effect upon kidneys, heart, liver, brain; alters all the internal organs and thus prepares the way for disease-producing microbes? . . .

All the natural cavities of the body opening exteriorly (the nose, mouth, alimentary canal) are filled with microbes that come from without, borne by the air or foods, and subsequently multiplying. There are even some for the skin. In the midst of these, there are others which are the remains of previous infectious diseases which have attacked the subject actually cured.

All microbes, in a normal state, live a latent life, often useful, as we have seen for digestion, most often inoffensive, thanks to the resistance of the cellular lining of the organic cavities, thanks to the activity of the white globules, zealous defenders of the organism, thanks to the chemical action of organic liquids. But when various circumstances, external conditions, or internal ones, modify these elements of defense, alter the texture of linings (as in the case of poisoning from the occupation), or when one or more of the microbes take a sudden virulence, then the barriers of protection are broken, the microbe enters into the interior of the tissues, and may determine the greatest variety of diseases, from pneumonia to erysipelas, meningitis or an abscess in the liver.

The microbes which live outside the organism have equally diverse origin. We have spoken already of the innumerable varieties living in the soil, the water, and on plants which play such numerous and important roles. Certain ones may, under the right conditions, take on a disease-producing power, and determine a disease, but there are others which, disease-producing by profession, have been eliminated from diseased organisms, and instead of having succumbed have fallen into the outer world, have adapted themselves to new places and live another life, it may be in the earth or in water. They are all ready, when introduced by food, or by respiration, to penetrate anew, into a living organism, to develop there, if the circumstances are favorable, the disease which they characterize, such as is the case with the *vibrion* of cholera or the bacillus of lockjaw. . . .

To these innumerable special causes of infectious diseases, the invasion of microbes and their development in the organism, hygiene may oppose numerous means of protection or of defense. This is the role of prophylactics. On the other hand, medicine may aid the system in struggling victoriously against the microbe: this is the role of therapeutics. But upon these two points the social influences have an important bearing: the place in society of the patient may modify profoundly these preventive measures and make them effective or insufficient, according to circumstances. . . . You see, then, though I have given only a simple outline of it, that the role of microbes in society is immense.

Bad or good, hurtful or useful, all have a role which is, on the whole, indispensable to the regular evolution of society. And, however paradoxical that assertion may at first have seemed, I believe I have given you a clear demonstration, and in closing, I may formulate it thus: Society could not exist, it could not live or subsist, except by the constant intervention of microbes, the great carriers of death, but also distributers of matter, and thus the all-powerful carriers of life.

Miscellaneous Notes.

Nature reports that the Czar has authorized the trial of tea culture on the eastern borders of the Caucasus, where the temperature is about the same as that of the parts of China where the plant thrives.

Les Annalen de Physikalischen Central Observatoriums, of M. Wilds, reports that a temperature of —69·8° C. (157·64° below zero, Fah.) was registered at Werckojansk, Eastern Siberia, in February, 1892. This is the lowest temperature which has ever been registered on the surface of the earth.

The Hungarian government has established an Institute of Bacteriology at Budapest, intended to facilitate the scientific study of infectious diseases.

Natural Science deplores the fact that there is no laboratory for psychological experiments in England, and speaks of institutions of this kind which exist on the Continent. *Revue Scientifique* (Paris), commenting upon this, says "there is only one such laboratory worthy the name in France," and adds, "It is in Germany, but especially in America that these institutions are well established, and any one in England who wishes to start one must look to these two countries for his inspiration."

The University of Edinburgh has taken steps toward some notable improvements. It is to have two new halls for public ceremonials; a third one is to be built as a dormitory for the women students; a chair of public health has been endowed; and, finally, a field for athletic sports has been bought at a cost of $45,000.

The Canary Islands possess not only the most wonderful climate, but an extremely fertile soil. The only difficulty in agriculture is the want of water. It has lately been found that there are great quantities of water in cavities of the mountains of Teneriffe. An English company has undertaken to get it out. They find that boring to a depth of a hundred feet is enough to procure a large supply of water. If they succeed in getting an unlimited supply in this way, the islands, which have declined in prosperity in recent years, will probably develop greater productivity than hitherto.

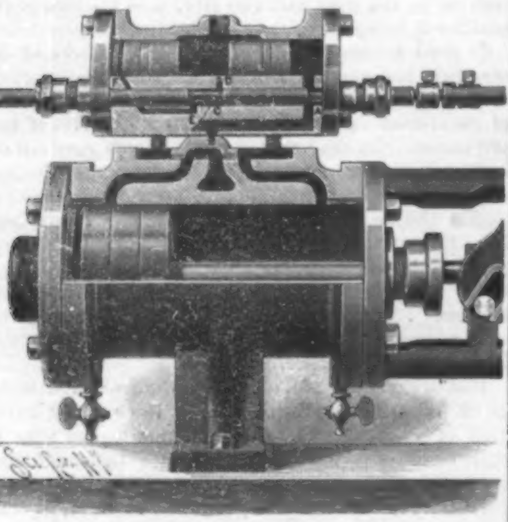
Russian industries are developing with great rapidity. In the construction of the new railway train for the Czar and his suite, Russian materials were used, with the exception of axles and wheels, which were furnished by the Krupp works, at Essen. This train consisted of eleven carriages, made after American models. Unusually strong brakes were attached, enabling the train to be brought to a standstill very suddenly.

Norwegian Cooking Stove.

During the last maneuvers in Russia experiments were made with the Norwegian cooking stove, the object being to provide the troops on the march, within the least possible space of time, with warm food. The apparatus used was the ordinary camp kettle fitted into a thick felt covering. The soup or stew being placed in the kettle is raised to the boiling point, and then removed from the fire, the lid clamped down, the kettle inserted in the sheath, and the whole slung in the usual manner below the wagon. The process of stewing continues automatically, thanks to the heat retained, and even after several hours' marching the temperature does not fall below 100° Fah.—*Journal R. U. S. I.*

AN IMPROVED STEAM ACTUATED VALVE.

The valve shown in the illustration is more especially designed for use with steam pumps, and is of simple and durable construction, very effective in operation, and arranged to positively control the movement of the main piston valve. It has been patented by Mr. Joseph J. Kwis, of Findlay, Ohio. The pump has the usual steam cylinder, with the end inlet ports and central exhaust port, controlled by the usual slide



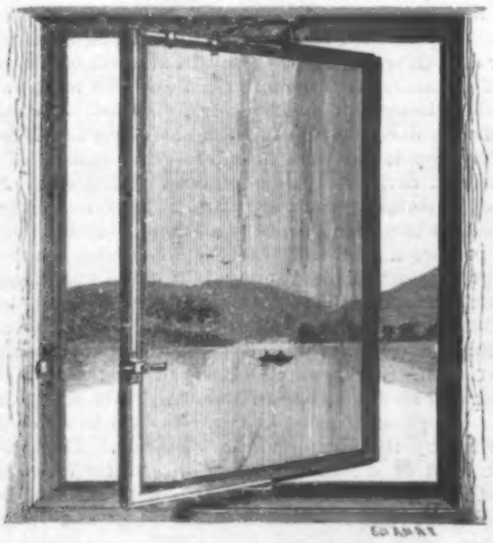
KWIS'S STEAM ACTUATED VALVE.

valve extending into the steam chest, within which also is an auxiliary piston valve adapted to be directly actuated from the piston in the steam cylinder, the steam chest having a main bore and an auxiliary bore. Steam inlet ports lead from the auxiliary bore to the ends of the main bore and exhaust ports independent of the inlet ports, and lead from the end of the main bore transversely through the auxiliary bore to the common exhaust passage. The auxiliary balanced piston valve sliding in the auxiliary bore has reduced portions controlling the steam inlet ports and the exhaust port, whereby the auxiliary piston valve is directly and positively actuated from the main piston rod, avoiding all undue friction, and positively shifting the main piston valve whenever the piston nears the end of its outward or inward stroke. In the illustration the exhaust is shown open at A, and enters main exhaust through the opening at B. The live steam which supplies the recess, C, is admitted through hole, D. The live steam port is shown open at E, and entering steam chest at F.

Further information relative to this improvement may be obtained of the Adams Brothers Company, the Findlay Machine and Boiler Works, Findlay, Ohio.

A WIDOW SASH FASTENER.

This is a device especially adapted for use in connection with window sashes pivoted at their centers at top



KIRSCH'S WINDOW SASH FASTENER.

and bottom, and is very simple, durable and inexpensive, and capable of quick and easy manipulation. It has been patented by Mr. Richard Kirsch, of Bay Ridge, L. I., N. Y. Near the upper central pivot of the sash an outwardly projecting rack is secured to the window frame, the rack being preferably of a quadrant form, and having a downwardly projecting flange which serves as a stop to prevent the sash from passing over a center line when opened. Extending across one side of the top rail of the sash, and passing adjustably through a block adapted to act as a pivot, is a locking lever, one end of which works in a bracket-like guide secured to the sash, there being at this end an adjustable locking pin adapted to engage one of the apertures of the rack. The locking lever is capable of lateral adjustment in its pivot block, and in an outer end block by which it is connected with a vertical connecting rod extending down one side of the sash. This rod is held to slide in one or more guides, and has at its lower end a guided movement in a plate in which is pivoted a connected operating lever, which may be either an elbow, an angle or a crank lever, forming a suitable handle by means of which the locking pin may be made to engage any one of the apertures in the rack, according to the position in which it is desired to adjust and lock the sash.

Protection of Iron from Rusting.

Mr. W. Thomson, of Manchester, is continuing his researches into the oxidation and corrosion of iron and steel; and he recently published some further observations on the subject in the *Journal of the Society of Chemical Industry*. According to this statement, Mr. Thomson had a number of sample pieces of thin sheet iron, of uniform size, weighed and painted with one coat of each of the paints, and weighed again; then left for about a week exposed to the atmosphere, and again weighed. The difference between the two first weighings gave the weight of the wet paint employed, which was calculated out to the square yard of surface; while the first deducted from the third gave the weight of dry paint. The coatings thus tested upon the sample strips, which measured 4 inches by 1¾ inches, varied in weight from ¾ ounce for linseed oil alone to 7 ounces for oxide of iron paint; tar weighed 1·56 ounces; solution of pitch, 1·24 ounces; red lead, 6·24 ounces; and so on.

Having tried in vain the effect of spraying the samples with a saline solution, Mr. Thomson proceeded to immerse the samples in a glass vessel containing sufficient saline solution to half cover each. He observed that, after two or three days, the clear solution began to grow turbid; and in a few days more it threw down a precipitate of the peroxide of iron. Some time later on it could be observed that the iron beneath some of the coatings of paint was undergoing oxidation to a much greater extent than others. It suggested itself to Mr. Thomson that if each plate of iron were placed in a separate glass beaker with the saline solution, the turbidity of the clear liquid would be some criterion of the progress of the rusting action. This was done in a case of a second series of experiments, which went to show that this observation is just; and Mr. Thomson was able to ascertain that oxide of iron paint, white lead, and the ordinary paints of commerce, have comparatively little protective influence on iron as contrasted with red lead, for the latter showed no signs of turbidity in the saline solution after all the others had become turbid, and deposited a considerable precipitate of ferric oxide. Mr. Thomson further lays stress on the electrolytic corrosion of iron; and he suggests that, for the protection of large iron structures from this effect, it might be advisable to place a large ball of zinc in wet ground in metallic contact with the iron of the structure by means of wires, which he believes would tend materially to prevent corrosion at comparatively small cost.

The Germ of Smallpox.

Professor Guamuri, of the University of Pisa, is of the same opinion as that published by him in 1892, in the *Archivi di Scienze Mediche*, viz., that the process of pustulation, both of cowpox and smallpox, is originated by a parasite which develops in the epithelial cells. He has studied both the morphology and biology of this organism. It is capable of amœbic movements, which can be seen on examination of lymph taken from the initial vesicle at the temperature of the human body. By this process Professor Guamuri has also verified the multiplication of the parasite under the microscope, and the fact of phagocytosis by polynucleated leucocytes. With a stain of gentian and methylene, the structure of this low organism may be studied. It consists of a roundish body with a clear outline. Professor Guamuri has succeeded in reproducing the parasite in the cornea of rabbits with inoculation of the same lymph, and he has verified the fact that no other source of irritation is capable of producing anything of the appearance of the same parasite in the cornea. Professor Guamuri believes that it is a zooparasite belonging to the class of rhizopode, and that it is the cause of both cowpox and smallpox.

A Home for Truants.

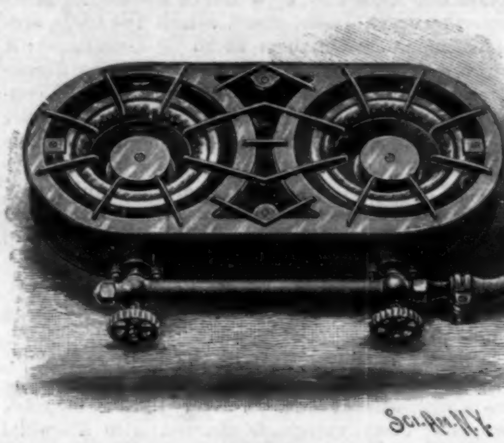
Boston is soon to have a home school for truants and troublesome boys. They are to be gathered into families of about twenty-five, under the care of a superintendent and his wife. A teacher of rare gifts of mind and heart is to be assigned to each group, and under his direction, three hours a day are to be devoted to study. The boys are to do all the household work and to cultivate the estate of thirty acres where the home is to be placed.

They are also to devote four hours a day to training for occupations to be had in the city.

The instruction on Sunday morning is to be moral and religious, and in the afternoon it is to be denominational.

AN EFFICIENT HEATING GAS BURNER.

As shown in detail in the SCIENTIFIC AMERICAN of April 7, the base of this burner, where it is attached to the gas supply tube, is supplied with apertures to admit air to mingle with the gas before it reaches the point of combustion, while the tube which surrounds the flame has air-receiving openings on its under surface and smaller air-discharging apertures in its upper surface, where the tube is impinged upon by the flame. The tube thus being raised to a high temperature, and correspondingly heating the air discharged therefrom to mingle with the burning gas, is designed to afford the most perfect combustion, with the attain-

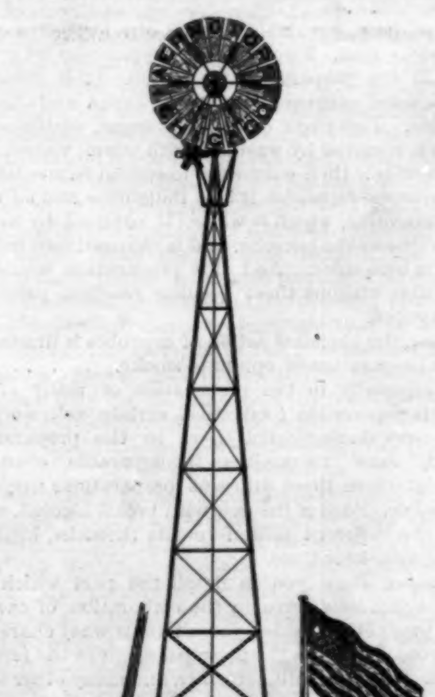


WILLIAMSON & BUZBY'S HEATING GAS BURNER

ment of the highest possible degree of efficiency for the quantity of gas consumed. The illustration represents the practical construction followed in the application of the improvement recently patented by Messrs. John R. Williamson and Isaac W. Buzby, of Seattle, Washington.

A HIGH WINDMILL.

Among the windmills shown at the late World's Columbian Exposition, that of the Aermotor Co., of Chicago, represented in the accompanying illustration, was perhaps the most unique and striking. It was 55 feet from the ground to the turret of the old Dutch windmill, from which sprang a galvanized steel tower 87 feet high, surmounted by a 16 foot wheel, making a total height of 150 feet. This windmill towered above



A HIGH WINDMILL.

all competitors at the Fair, and around the lower structure was a balcony nearly 150 feet in circumference, from which an impressive idea of the height of the tower was obtainable.

THE BICYCLE UPON RAILS.

It is from Russia this time that comes to us a curious cycling apparatus. The accompanying engraving reproduces a photograph taken in the vicinity of Moscow a few hours previous to the passage of the imperial train. Some Russian gendarmes, one of whom is seated upon the apparatus, have just made an inspection of the track. The Czar may now pass, as there is nothing to be feared from the Nihilists!

As will be understood, the person in the center is utilizing a sort of bicycle for his police service which rolls upon the rails of a railway track. In reality, the word bicycle is a misnomer for this apparatus, which rests upon three wheels. Through its two principal wheels it rests upon the rail to the right, but is kept in equilibrium by a metallic arm terminating, on the rail to the left, in a small wheel. It is a crude apparatus, moreover, whose two heavy main wheels are connected by a compact body, the various parts of which are roughly shaped, and which weighs no less than 110 pounds.

As primitive as the machine is, however, it exhibits some very original peculiarities. It is actuated both by the arms and legs of the rider, and thus puts one somewhat in mind of the Valere running machine. Here, the rider, not having to occupy himself with the steering of the machine, since the latter, being fitted to the rails, follows all the curves thereof, devotes his entire attention to its propulsion. Two levers, actuated by the arms, are, through a slide at their lower extremity, connected with each of the cranks of the bicycle. It will be remarked that, contrary to the arrangement of the Valere machine, which causes its rider to take an ambling gait (that is to say, causes him to put forward at the same time the leg and arm of the same side), the Russian railway bicycle employs the ordinary gait of man's trot, that is to say, causes the rider to put forward at the same time the right arm and left leg, and reciprocally.

We shall not expatiate here upon the genuine services that may be rendered by this inexpensive and very rapid apparatus, which necessitates scarcely any cost of maintenance and which one man can easily remove from the track, in order to allow a train to pass, and afterward replace upon the rails. It is too evident that the switchmen, inspectors and engineers of railways would find it of great interest to utilize it according to circumstances.

Much is being said about military cycling; we are not so very sure whether in time of war railways would not be the only routes cyclable. We may remark, however, that this homely Russian apparatus is not an innovation, but far from it. Almost from the inception of cycling it has been understood that the railway is the most practical, the surest and best rolling roadway. The oldest example of cycling upon rails that we know of is mentioned in the *Albany Courier* of August 20, 1869, which states that upon the banks of the Mohawk, two landowners had had constructed for themselves, in order to visit their possessions, small cars that they actuated by their arms and legs upon the railways.

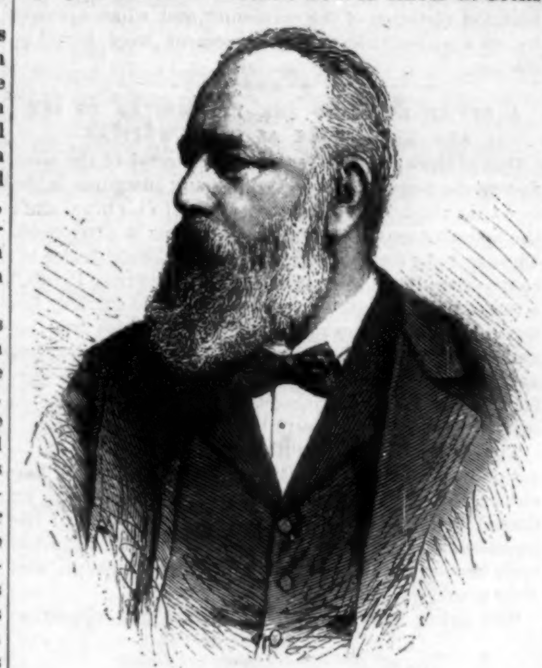
This journal adds that one evening, in a fit of jealousy, the two inventors ran into each other upon an embankment one hundred feet in height, in a sort of real Yankee duel, and that the cars were smashed and one of the duelists was killed outright. Without dwelling upon this perhaps fanciful story, we shall further recall that at Paris, on the 28th of December, 1887, the military engineers, represented by Capt. Houdaille, tried a railway quadricycle, constructed by Mr. Vincent, upon the line of the East, near Villette. A speed of 18 miles per hour was obtained. Unfortunately the apparatus weighed 198 pounds, and for this reason was abandoned. Afterward, Truffault, the bicycle manufacturer, who played so important a part in the history of cycling, established after the manner of the Americans a railway quadricycle that weighed but 55 pounds, and gave a speed of 24 miles per hour upon a level. The French state railways began some experiments in 1891. It is now 1894, and the experiments are being carried on without any conclusion as yet. It is fortunately necessary now to rely much in France upon the example of Russia.—*La Nature.*

BICYCLE FOR THE INSPECTION OF RAILWAY TRACKS.

THEODOR BILLROTH.

One of the brightest stars in medical science—the last of the triple star—Langenbeck-Volkmann-Billroth—is extinguished.

Theodor Billroth was born April 26, 1829, at Bergen, on the island of Rugen. His father, who was pastor at Bergen, died early, leaving the son to be brought up by his mother. Later he went to school at Greifs-



THEODOR BILLROTH.

walder, and in the years 1848 to 1852 he studied medicine in Griefswald, Gottingen and Berlin. He carried his studies farther than many, working as diligently at the natural sciences as at medicine.

In addition to the usual journeys to Vienna and Paris for the purpose of study, Billroth had a thorough drill in the surgical clinic in Berlin, where he acted as Langenbeck's assistant in 1853. The master soon recognized the ability of the youth in working out microscopic, anatomical and histological questions, and the importance of such fundamental investigations for practical surgery. Thus we see him here occupied chiefly with study of an anatomical and physiological nature, and with experimental pathological work which paved the way for a new era in surgery. With wonderful adaptability he studied many subjects during his seven years in Berlin. Embryonic studies led him to an understanding of the development of the blood vessels and a careful study of unhealthy formations. He also produced at this time an excellent work on "Umwandlung von Muskel- und Nervengewebe" ("Transformation of Muscle and Nerve Tissue"), an historical study of the treatment of gunshot wounds from the fifteenth century to the present time, and his "Beitrage zur Pathologischen Gewebelehre" ("Contributions to the Science of Pathological Histology"), an especially important work that brought to light much that was new.

It took him only ten years to rise from the position of student to that of professor and scientist. In 1859 he was called to Greiswald as professor of pathological anatomy. Fortunately for surgery, he refused this flattering call, but two years later he accepted a call as professor and director of the surgical clinic in Zurich. He left here in 1867 for a similar position in Vienna. When in the Swiss high school his great industry and brilliant surgical talent showed to advantage, and his methods of work here, following up the questions of the day in his studies and his teaching, are set forth not only in his "Clinical Reports," but also in his "Fifty Lectures on General Surgical Pathology and Therapeutics," a work of classical value and universal importance that lived through many editions and was translated into all civilized languages. In Vienna he continued to publish his experiences in "Clinical Reports," and he and Pitha produced the great compilation "Handbuch der Allgemeinen und Speciellen Chirurgie" ("Handbook of General and Special Surgery"), which is prized by physicians in all parts of the world as a mine of surgical experience.

Lister's epoch-making discovery of the use of antiseptics in operations, which opened to surgery heretofore unsuspected paths, was not without its effect on Billroth. He was one of the first in Germany to acknowledge and appreciate the importance of the antiseptic method. With his accustomed zeal he undertook the study of the suppression of surgical fevers and diseases, but he was not tempted even by his great success to perform unnecessary operations. Step by step he followed up carefully the branch of surgery which had been so suddenly opened, and we have to thank him for many operations in internal surgery that are of the greatest importance in saving life, and such as no one had dared to perform before. Among these we may mention the removal of the larynx and the resection of the pylorus end of the stomach, which added new leaves to his crown of laurel. This was before the time of Koch; but Billroth was then a pioneer. By his work on the vegetable nature of the septic coccus bacteria, he increased the knowledge of wound infection so that he might be called the apostle of antiseptic surgery.

His ability in two other branches should be mentioned here, viz., that of military surgery and popular authorship. As a result of his voluntary service in the Franco-German war, he presented the medical world with "Chirurgischen Briefen aus den Kriegslazarethen von Weissenburg und Mannheim," 1872 ("Surgical Letters from the Hospitals of Weissenburg and Mannheim"), as well as with his dissertations on the transportation by railroad of those wounded and taken ill on the field (1874). As a teacher of the people he published, in 1881, a handbook on "Die Krankenpflege im Hause und im Hospital" ("Care of the Sick at Home and in the Hospital"), that has been universally translated, and shows how a true German savant can present questions of hygiene in a form that is agreeable and at the same time comprehensible to the uninitiated.

Billroth has taught many famous pupils, and the students' thorough appreciation of his ability as a teacher is shown by the document which they presented to him on the occasion of the anniversary of his fiftieth term at Vienna (1892). In his "Lehren und Lernen der Medicinischen Wissenschaften" ("Teaching and Learning Medical Science"), 1876, he made a valuable gift to those who are interested in reform in medical instruction.

Billroth was a person of the greatest charm; his finely formed head, clear eye, and brilliant oratorical gifts will long be remembered by all who knew him. He was a real "path finder" for his associates, his bold and successful methods of performing operations restored thousands of suffering people to health, and being extremely self-sacrificing and magnanimous, he was a true benefactor to the sick and a fatherly friend to the student. — *Illustrirte Zeitung.*

THE strongest animals in the world are those that live on a vegetable diet. The lion is ferocious rather than strong. The bull, horse, reindeer, elephant and antelope, all conspicuous for strength, choose a vegetable diet.

[CHAUTAUQUAN.]

What is Chemistry?

Everybody who thinks must be impressed by the great variety of things found on this earth, and the question, What does the earth consist of? must often suggest itself. Among the important results reached in studying the things around us is this, that notwithstanding their great variety they are made of simple things, and these in turn of still simpler—that there are, in fact, only about seventy distinct kinds of matter, and that all the complex things around us are made up of these seventy elements. The solid crust of the earth, as far as it has been possible to investigate it, all living things, both animals and plants, the air and water, consist essentially of twelve elements. The elements do not, as a rule, occur as elements. They are generally found in combination with one another. Oxygen and nitrogen are, to be sure, found in the air as elements, uncombined; but such familiar substances as water, salt, and quartz consist of elements in combination. Thus water consists of hydrogen and oxygen. Hydrogen, the element, is a colorless, tasteless, inodorous, and very light gas that burns readily. Oxygen, the element, is also a colorless, tasteless, inodorous gas. It does not burn, but burning things burn with much increased brilliancy in it. When hydrogen and oxygen are mixed together in a vessel under ordinary conditions, no action takes place. They mix thoroughly, forming a mixture that is also a colorless, tasteless, inodorous gas. If a spark is applied to this mixture, a violent explosion occurs, and this is the signal of a great change. The two gases have entered into chemical combination; they are no longer the gases hydrogen and oxygen; they have entered into combination and now form the liquid water, a substance with properties entirely different from those possessed by the constituents.

Again, chlorine, the element, is a greenish-yellow gas that acts violently upon other things and causes changes in them. Inhaled even in small quantity it gives rise to distressing symptoms, and in larger quantity it causes death. Its odor is extremely disagreeable. Sodium, the element, is an active substance that has the power to decompose water and set hydrogen free. When chlorine gas is brought together with sodium, the two combine chemically and form the well known compound salt, or, as the chemist calls it, sodium chloride. From this the elements chlorine and sodium can be obtained by the chemist. These two examples serve to show what is meant by chemical combination and by a chemical compound. Chemical compounds are generally found mixed with other compounds. This is shown, for example, in many of the varieties of rocks, as granite, which consists of three different chemical compounds. It is shown much more strikingly in living things, all of which are made up of a large number of chemical compounds, mixed, to be sure, not in a haphazard way, but beautifully adjusted and working together in wonderful harmony. Just as elements combine chemically to form compounds, so elements act upon compounds and cause changes in their composition. Thus, oxygen is constantly acting upon other things, sometimes slowly, but, in the case of fire, rapidly and with tremendous energy. It is commonly said that fire destroys things. In fact, it changes their composition, and the principal products of the change are gases. This kind of chemical change is the most familiar that is brought about by the action of an element upon compounds. Compounds, too, act upon compounds, and cause an infinite number of changes in composition. Thus the food we partake of consists of chemical compounds. In the body these compounds find others and they act upon one another so as to repair the wasted tissues and cause growth. The gas known as carbonic acid, that is contained in the air, acts upon the compounds in the leaves of plants and causes changes that are absolutely essential to the life and growth of the plant.

Look, then, in any direction and you will see evidence of changes in composition that are constantly taking place, and that are essential to the existence of the world as it is. These changes in composition and the compounds themselves that are involved in the changes form the subject of chemistry. In the light of what has been said it is clear that chemistry must be a very broad science. Remembering that chemical action is the cause of the formation of chemical compounds, that without chemical action the compounds would cease to exist and would be resolved into their elements, it is impressive to think what would take place if chemical action should cease. Most of the things familiar to us could not exist. The solid portions of the earth would, to a large extent, be replaced by the element silicon, something like charcoal, and by oxygen and a few metals such as sodium, potassium, and aluminum. Water would be resolved into the two gases hydrogen and oxygen. All living things would fall to pieces, and in their place we should have the gases, hydrogen, oxygen, and nitrogen, and the solid element carbon, most familiar to us in the form of charcoal. Life would, therefore, be impossible.

New Cave Discoveries at Mentone.

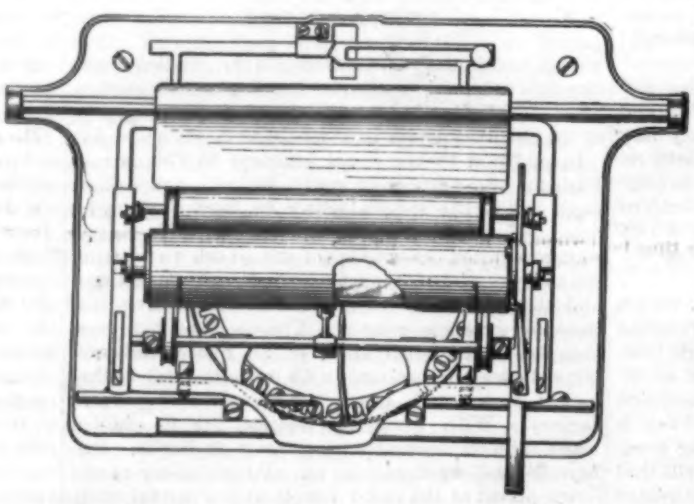
The first discovery of a skeleton and some other remains at Mentone, France, was made in 1872.

In January last another skeleton was found. It is that of a man almost six and a half feet tall; it was lying on the back with the left hand under the head. Around it were bones of animals, perforated shells and stag's teeth. Near by were a very sharp unused flint knife and a crystal of carbonate of lime. In the neighborhood vertebræ of the mammoth and what appears to be a paleolithic stone implement were found.—*Globus.*

A DEVICE ENABLING THE TYPEWRITER TO SEE AND READ WORK AS IT IS WRITTEN.

One of the annoying features of several of the most deservedly popular of the typewriting machines is the fact that the carriage has frequently to be lifted, that the operator may examine the work as it progresses. The necessity for this is obviated by a simple device recently introduced and styled the "Typewriter Prism," a rod of polished cut glass fastened to the carriage beneath the impression roller. Two of its sides are flat and inclined to each other at an angle of 45 degrees, and the third side is a strong cylindrical curve, perfectly reflecting the writing and presenting it right side up and in normal position to the eye of the operator.

The accompanying engraving illustrates the application of the improvement to the Smith-Premier machine, the position of the prism being shown by dotted lines on and in a broken-away portion of the impression roller. The prism can also be adjusted with best results to the Remington, Caligraph and Yost machines.



TYPEWRITER PRISM APPLIED TO SMITH-PREMIER MACHINE.

The prism in no way interferes with the operation of the machine, and when a letter has been omitted or a wrong letter struck, the carriage can be instantly moved to the desired point and the correction made without lifting the carriage to locate the error, while it is the only device yet invented enabling the operator to tabulate conveniently. The prism has been in use in the office of the SCIENTIFIC AMERICAN for some time and has given much satisfaction. A great many operators are using this improvement, of which Mr. Birket Clarke, 106 Fulton Street, New York, is the general agent.

Liquids and Gases.

It requires some effort of imagination to think of a gas so compressed as to have a density nearly equal to the density of water, and to possess the consistence of tar or of honey; very slightly compressible, like a liquid, and nevertheless a gas. So we need not wonder that even physicists, who at times are bold enough in their hypotheses, were rather slow in accepting a conception so widely different from our daily experience of liquids and gases. Such a state of matter is, however, known; it has been observed in our laboratories, and its existence was indicated as early as 1822, by Cagniard-Latour, and later on by Faraday. But it was only in the seventies, after two such bright minds as the Belfast professor, Andrews, and the Russian professor, Mendeleeff, came—the one through experiment and the other theoretically—to recognize its reality and significance, that scientists came round to the view that matter may exist in a state intermediate between its liquid and gaseous states. The idea is now generally accepted, and during the last five and twenty years immense researches have been made upon or in connection with this subject. Andrews made his discovery while liquefying carbonic acid gas. Unlike oxygen or nitrogen, which both require very low temperatures for being brought into their liquid state, carbon dioxide liquefies very easily. At the temperature of the freezing point it is sufficient to exert upon it a pressure thirty-six times greater than the pressure of our atmosphere to have it as a liquid, the density of which is four-fifths of the density of water. If its temperature be raised to 59° Fahrenheit, a pressure of 52 atmospheres is again sufficient to overcome the tendency of its molecules toward scattering in space; it becomes a liquid.

But when Andrews took the same gas at a temperature of 96°, he could exert upon it a pressure of 108 atmospheres and more without seeing any traces of liquefaction. Under this pressure the gas was reduced to $\frac{1}{418}$ part of the volume it occupied at the freezing point; its density was equal to the density of liquid carbonic acid, and yet it was not a liquid, although, like a liquid, it yielded but little to a further increase of pressure. However, as soon as its temperature was brought below 88°—the pressure remaining the same—the gas was found to be in a liquid state, without any alteration of its volume, or any sudden evolution of heat, having taken place. A temperature of 88° is thus its critical point. Below that limit its liquefaction is easy; above it, it is impossible. Further experiments convinced Andrews that other gases behave in the same way at their own critical temperatures, and he at once understood the philosophical bearing of his observations. There is, he wrote, a close and intimate connection between the ordinary gaseous and the ordinary liquid state of matter. The two are but widely separated forms of the same condition, and they may be made to pass into one another by a series of gradations so gentle that the passage shall nowhere present a breach of continuity. From carbonic acid as a perfect gas to carbonic acid as a perfect liquid the transition may be accomplished by a continuous process. But if any one ask whether the carbonic acid, taken at a temperature above its critical point, be in its gaseous or liquid state, the question does not admit of a positive reply. It stands "nearly midway between the two, and we have no valid ground to assign the one or the other." As to the explanation of this state, it must be sought for in the cohesion between the molecules; and further research, he added, will probably disclose the continuity of the liquid and solid states as well.

Andrews came to his discovery by starting from the gaseous state of matter; Mendeleeff came to the same discovery by starting from the liquid state. All liquids, he wrote in 1861, have a certain cohesion between their particles; this is what distinguishes them from gases; but the heating of a liquid steadily diminishes its cohesion, and consequently there must be for each liquid a certain temperature (the absolute boiling point) at which cohesion between its particles must entirely vanish, so that at and above that temperature it cannot exist as a liquid. It must then form a gas, and so long as it has not been cooled below the above limit, no amount of pressure will be able to restore it to its liquid state. Thus, starting from the two opposite ends of the scale, Andrews and Mendeleeff came to identical conclusions. Deduction and induction had joined hands. It is now known that their generalization was correct. All physical bodies have their critical temperatures or absolute boiling points, above which they cannot exist as liquids, whatever pressure they might be submitted to. For water this critical point is 689° of the Fahrenheit scale; for ether it is 383° or 386°; but for several gases it lies so deep that in order to liquefy them one must approach the absolute zero (459° below the freezing point), at which no thermic vibrations exist and even chemical affinity disappears unless stimulated by electricity. Thus, oxygen must be cooled down to 299° below the Fahrenheit zero, and nitrogen to —315° in order to be liquefied; while the critical temperature of hydrogen must be still lower—somewhere about 360° of cold. This is why Professor Dewar, who liquefies air in an open tube—that is, at the ordinary atmospheric pressure—could not yet liquefy hydrogen in the same way; and Amagat saw this gas at the ordinary temperature of our rooms remaining a gas, even under a pressure of 2,800 atmospheres, when it was squeezed within one-thousandth part of its previous volume.—*Prince Kropotkin, Nineteenth Century.*

Opening of the Exhibition at Lyons, France.

The great Exhibition of Arts, Sciences, and Industries was opened at Lyons April 29. A throng of conspicuous men attended the ceremonies. The whole Cabinet was present, but the President was unable to come. The exhibition, although formally opened, is far from ready for the public. The interior of the main building is still in the hands of the carpenters and the decorators. The main building covers 5,000 square yards, and is surmounted with a fine cupola. There are large pavilions for exhibits of viticulture and agriculture, greenhouses, and buildings for the fine arts.

Correspondence.

How to Make Magnets.

To the Editor of the Scientific American:

It is frequently asked, "how to make and charge magnets." It is somewhat a vexed question. The plan of touching the steel to be magnetized to the pole of a dynamo is beset with this difficulty: The field is so large, and the currents so strong, that if one pole of a U magnet is laid on the pole of a dynamo, the influence of the polarity of the dynamo will extend beyond the contacting pole of the U magnet and partly destroy the polarity that should arise in the off or farthest pole of the U magnet. I have devised and successfully used a plan that I give to the readers of the SCIENTIFIC AMERICAN. First, I take good tool steel, harden at the ends, and draw the temper to a bluish straw color or edge tool hardness. Next, take a piece of one inch iron gas pipe, about eight inches long, then fill the hole from end to end with one quarter inch iron rods, filling the interstices with smaller iron wire. Dress both ends smooth. Now, if there is a friendly street car or electric light dynamo in reach, apply *one end of the gas pipe* to either pole of the dynamo, and draw the U magnet at right angles with the end of the pipe that sticks out. Apply the U steel about half way from the bend to the point or pole. Draw the U then down to the point until it leaves the pipe, then draw the U away, and apply in the same manner again, using care not to approach the U any nearer to the dynamo than the outer end of the gas pipe. Then take the gas pipe to the other side of the dynamo and treat *the other pole of the* U in the same way. I made a magnet in this way that held up four and five-eighths its weight, which is esteemed excellent magnetism. ROY A. CRIHFIELD.

[The above plan answers very well, but two rods of iron applied one to each pole would probably prove more effective. It would be necessary to clamp the two bars rigidly to prevent them from being drawn into contact with each other.—EDS.]

[FROM THE SUN, NEW YORK.]

The Starry Heavens in May.

The Lion watches in mid-heaven and Saturn rules the night. At 8 o'clock in the evening at the beginning of May the constellation Leo may be seen upon the meridian, its star-marked figure of a sickle standing upright in the sky near where the sun had been at noonday. Following Leo from the east comes Virgo, made doubly beautiful and interesting at this time because of the presence of the planet Saturn near its chief star Spica. Saturn is the brighter of the two, and is situated about five degrees north of Spica. By 10 o'clock they are so high up toward the meridian that Saturn can be studied to advantage with a telescope. Its rings are slowly opening wider, and the spectacle they present is unmatched in any part of the universe yet brought within the reach of human eyes. The nearest approach to the form of Saturn's rings that I have ever seen in the heavens is presented by a little nebula in the constellation Gemini, which I had the pleasure of viewing through the Lick telescope with Prof. Barnard last autumn. With most telescopes this object appears only as a rather curious planetary nebula, but with the great glass on Mount Hamilton it is seen to consist of a round, nebulous disk, having a star set in its center, and something like half way from the center to the circumference of the luminous disk is a circular division, looking exactly like a narrow black ring encompassing the star, and sharply contrasted with the glow of the nebula within and without. It seems impossible to resist the conclusion that this phenomenon possesses a real resemblance to the rings of Saturn, but in place of a planet it presents a sun, and, instead of a system of meteoritic rings 170,000 miles across, it shows us circles of glowing nebulous matter that may well be hundreds of millions of miles in diameter!

It ought to be the aim of every educated person to get a look at Saturn with a powerful telescope at least once in a lifetime. The first glance may be disappointing, but the second will make an unfading impression. There is no science in which seeing begets thinking as it does in astronomy.

But while Saturn holds the place of honor during the month, its more distant planetary comrade, Uranus, commands attention also. On the third, Uranus, still remaining near the star Alpha in Libra, will be in opposition to the sun, and in the best situation for telescopic observation.

It is a curious fact that all four of the first discovered asteroids, Ceres, Pallas, Juno, and Vesta, are now visible simultaneously, and three of them, Ceres, Pallas, and Vesta, are in the constellation Leo. Juno is in Serpens, just above Libra, and some 15 degrees from Uranus. Unfortunately none of them can be seen with the naked eye. These are the little planets whose discovery early in the present century led to the theory, now generally abandoned, that they were the fragments of an exploded world. The largest of them, Vesta, is probably not less than 300 or more than 500 miles in diameter. But since the discovery of the original four several hundred smaller asteroids have been found, and now celestial photography is adding dozens of them to the list every year. Some of these are, no doubt, only five miles or less in diameter. On a 5-mile world, if it had the same average density as the earth, a 200-pound descendant of Adam would weigh only two ounces, and a cannon ball dropped from his hands would require a quarter of a minute to reach his toes; and it wouldn't hurt when it hit. He could hurl a stone that would weigh a ton on the earth with such velocity that it would escape from the attraction of the little world and never come back to it.

The May moon begins its career on the 5th at 9:42 A. M., attains first quarter on the 12th at 1:21 A. M., fills on the 19th at 11:43 A. M., and reaches last quarter on the 27th at 3:04 P. M. Its visible course lies through many interesting constellations. As it emerges from the sun's rays it enters Taurus, meeting Jupiter and the Pleiades on the 6th. From Taurus it enters Gemini, passing on the way through a part of Auriga. On the evening of the 9th it will be near the celebrated twin stars, Castor and Pollux, and will serve to point them out to those who do not already know them. Crossing Cancer, with its strange glimmering "beehive," and its sprawling lines of stars outstretched in true crab fashion, the moon will enter Leo and be near the bright star Regulus on the evening of the 12th. Having traversed Leo, it will be found on the 15th in Virgo, south of the great Field of the Nebulæ, where those mysterious objects are scattered like thistle down over the face of the sky—an unfinished corner of creation which might well represent that wild abyss of chaos through which Satan took his flight when, as described by Milton, he went in search of the newborn earth:

> Fluttering his pinions vain, plump down he drops
> Ten thousand fathom deep, and to this hour
> Down had been falling, had not by ill chance
> The strong rebuff of some tumultuous cloud,
> Instinct with fire and niter, hurried him
> As many miles aloft; that fury strayed,
> Quenched in a boggy Syrtis, neither sea,
> Nor good dry land, nigh foundered on he fares,
> Dreading the crude consistence, half on foot,
> Half flying. . . .
> O'er bog or steep, through strait, rough, dense, or rare,
> With head, hands, wings, or feet, pursues his way,
> And swims, or sinks, or wades, or creeps, or flies.

Unfortunately the light of the moon renders the observation of nebulæ exceedingly difficult, and the reader who wishes to explore this wonderful region with a telescope must wait until the end of the month, when, in moonless nights, the pale gleam of these unhoused ghosts of the sky, these uncreated worlds, will tantalize the sight, and awaken in him a new sense of the mystery of the universe.

Having passed close to Saturn on the 16th at noon, the moon will cross from Virgo into Libra, and will, on the morning of the 18th, pay its respects to Uranus. Thence on into Scorpio Diana's course will lie, and as, on the morning of the 20th, she passes Antares, that great red sun, which conceals a smaller bright green luminary in its blaze, her form will show the first evidence of decay; from the full moon phase she will have begun to decline toward last quarter and toward extinction. On the 21st she will be in Sagittarius, wading through the broad shallows of the Milky Way, which there spreads wide and divides into currents and pools interspread with islands of stars. On the 24th she will be in Capricorn; on the 27th in Aquarius, and at 3 o'clock in the morning of the 28th she will be very close to the planet Mars. From Aquarius she will pass into Pisces and Aries, and her fading form, become now a very thin crescent, will disappear in the rays of the morning sun at the opening of June, until, rejuvenated, she shines again in the sunset glow, the celestial queen of the month of roses.

Both Mars and Venus will remain morning stars during May, but Venus is fading, and Mars has not yet come into a position to command general attention. Next summer and autumn the eyes of the world will be upon him. Then the poet's dream will come true:

> And the first watch of night is given
> To the red planet Mars.

Mercury will be hidden in the sun's rays during the month, but it is interesting to follow that little world with the mind's eye, for on the night of the 22d Mercury, then on the opposite side of the sun from us, will be in perihelion, or at its nearest approach to the sun. This means a great deal more for Mercury than it does for the earth. Our distance from the sun varies only about 3,000,000 miles, which cuts no great figure in a total distance of more than 90,000,000. But Mercury, whose average distance from the sun is only 36,000,000 miles, is at perihelion 14,000,000 miles nearer to the solar furnace than at aphelion! When furthest from the sun that planet endures a degree of heat more than four and a half times as great as the earth receives, while when it is nearest to the sun, as it will be on May 22, it broils under a temperature eleven times as intense as that with which the sun warms the earth. All the water must be steam on the planet Mercury, except, perhaps, around the poles. As the summer heats come on we may possibly find some comfort in thinking how much worse it would be if we lived on Mercury. This world of ours evidently does not deserve the evil reputation that some people would fasten upon it. Our worst discomforts assume a pleasant aspect when compared with roasting on Mercury or freezing on Saturn.

But there is another thing to be considered about Mercury: apparently it is not blessed like the earth with the rapid alternation of day and night. Signor Schiaparelli, the authority of whose eyes is great among astronomers, says Mercury keeps the same side always facing the sun. If so, that world has a day hemisphere and a night hemisphere. Which is inhabited, if either? Can people live where the sun never shines? Can people live where the sun always shines? If they can endure the unending night on the sunless side, they may have some compensations; they can see Venus and they can see the earth, both more brilliant in their sky than any star or planet ever is in ours. On the other hand, if they choose to live on the sunward hemisphere of their world, their lot cannot be altogether a happy one. Accustomed as they may be to a greater heat than we endure, they yet have to face most trying alternations of temperature. They are now rushing toward perihelion with fast increasing velocity, for Mercury travels 35 miles in a second at perihelion and only 23 at aphelion, and we may well pity them as they whirl along out of our sight behind the sun, for three weeks from before the end of May they will be broiling under a temperature much more than twice as hot as that from which they suffered only three weeks previously.

But if this picture is unpleasing to the imagination, we can substitute for it another, in which Mercury appears as a barren rockbound globe—hot, dry, and hard-baked by the close and unclouded sun. And, indeed, the latest results of investigation favor the view that Mercury is a lifeless planet. But has it been always so? GARRETT P. SERVISS.

Sand as a Filtering Medium.

Dr. G. Gore has communicated to the Birmingham Philosophical Society the results of an experimental research on the "Decomposition of Liquids by Contact with Powdered Silica." By placing a solution of an acid, salt, or alkali, of known composition, which had no chemical action upon pure precipitated silica, in a stoppered bottle, adding to it 50 grains of the silica, thoroughly agitating the mixture, and after sixteen hours analyzing the portion, he found the chemical composition of the film of liquid which adhered to the powder to be stronger in the chemical than the solution itself. The amount of solid abstracted from the solution varies with the kind of powder employed, its degree of fineness, the kind of dissolved substance, the proportion of powder to it, the kind of solvent, the proportion of solvent to powder, the proportion of dissolved substance to solvent, and, in a small degree, with the temperature. The union takes place quickly, and prolongation of the immersion has but little influence. Finely precipitated silica possesses the property in the greatest degree, and alkaline substances are the most affected; with very dilute alkaline solutions more than 80 per cent of the dissolved substance was abstracted by the silica. The results appear to throw some light upon the purification of water by filtration through the earth and upon agriculture, and to show that the alkaline constituents of soils are retained much more by the silica than by the alumina. The effects of silica upon weak solutions of potassium cyanide indicate that the great loss of the latter substance in the commercial process of extracting gold and silver from powdered quartz is largely due to the "adhesion" of that salt to the silica. The results obtained with a very weak solution of iodine indicate a possible method of extracting the latter substance from solutions.

Limit of Employers' Liability.

An employe of the Buffalo Car Company was injured four years ago by the breaking of a belt on a planer, one eye being destroyed. He sued for damages in the Supreme Court before Judge Childs, in 1890, and the case was dismissed without the defense being heard. A new trial was granted by the General Term. This was held before Justice Ward in 1892, and resulted in a verdict of $3,000 for the injured man. The car company appealed and the judgment was sustained. The case was then carried to the Court of Appeals, which has just decided in favor of the car company. In the review of the case this statement is made:

"The master does not guarantee the safety of his servants. He is not bound to furnish them an absolutely safe place to work in, but is bound simply to use reasonable care and prudence in providing such a place. He is not bound to furnish the best known appliances, but only such as are reasonably fit and safe. He satisfies the requirements of the law if, in the selection of machinery and appliances, he uses that degree of care which a man of ordinary prudence would use, having regard to his own safety, if he were supplying them for his own personal use. It is culpable negligence which makes the master liable, not a mere error of judgment."

THE PARK AVENUE IMPROVEMENT IN NEW YORK CITY—THE TEMPORARY HARLEM RIVER BRIDGE AND THE MOVING OF THE MOTT HAVEN STATION.

(*Continued from first page.*)

1892, which moving was quite a remarkable engineering achievement. The tower alone was transferred, the old lift span being left to form a part of the permanent way.

Now the tower stands in line on the new bridge, a lattice truss draw span has been supplied, and at midnight on Sunday, May 6, the operation of turning the rails and making connections for the temporary bridge began. The newspaper train leaving the Grand Central Depot at 4:40 A. M. was the first train to pass over the line. Our illustration shows the bridge with the draw span hoisted.

The length of the draw span is 108 feet, its width is 19½ feet, it is carried by 7½ foot deck trusses, and its weight is 127·7 tons. It is hoisted by a cable hoist, and counter-weights are employed to facilitate the raising. It will be seen that owing to the moment of the structure varying, the counter-weights should also vary. They are accordingly distributed in 22 sections, the uppermost weighing 3,600 pounds, the lowest 4,900 pounds, while the intermediate ones vary proportionately. As the span rises it deposits the weights one by one, and as it descends picks them up again in the reverse order. Two double cylinder Crook hoisting engines are used to raise it, the steam for which is supplied by two boilers. Spiral springs are introduced between the counter-weights in order to prevent shock or jar. Two minutes' time is occupied in hoisting. The relation of the old and new temporary tracks, where the bridge now stands, is shown very well in the cut in our issue of December 31, 1892.

The Mott Haven station was situated on the west of and close to the tracks used by three railroads, the New York Central, New York and New Haven and the New York and Harlem Railroads, immediately north of the bridge. Two tracks occupied the roadbed. The place was reached by a curve. Two operations were contemplated by the engineers for this place—the road is to be changed to a four-track way and the curve is to be made an easier one. It therefore became necessary to move the station fifty feet to the west to give room for the four tracks on the newly determined curve. The station is a brick building 185 feet long and averaging 35 feet in depth. The tower, which is seen in the cuts rising to one side of the center of the front, is 19 feet square and 80 feet high. The weight of the tower alone is estimated at 500 tons, the rest of the building weighing 1,200 tons. Messrs. B. C. Miller & Son, of Brooklyn, N. Y., the firm that moved the Brighton Beach Hotel in 1888, were in charge of the moving, which was recently executed with great success. The problem was a very difficult one, as the least inequality in support or in moving strain would have cracked the brickwork.

The building was first placed upon Georgia pine blocking, generally of 14 × 14 inches cross section, the distribution of the underpinning and ways being shown in the cuts. The weight to be moved was so great and the building so liable to damage that the ordinary system of blocks and falls and windlasses was discarded in favor of jack screws. Fourteen jack screws, each of ¾ inch pitch, 8½ inches diameter and 12 inches long, were distributed along the front of the building. Each screw had as abutment for its outer end or head heavy timbers secured to the ground ways by chains. The other or threaded end of the screw entered a hollow beam, such as used by builders, and the end of this beam bore against the transverse sliding ways.

Soap was first applied to the ways by rubbing on the exposed surfaces, while between sliding and ground ways, where one crossed the other, thin slices of soap were introduced. The surfaces were then further lubricated with tallow, and all was ready for the start. The screws were turned until all felt the strain. There were four screws along the tower point. These were gradually turned until the tower moved a perceptible amount—perhaps a sixteenth of an inch. Then the whole series of fourteen screws were turned in unison by stroke of bell. At each stroke one-quarter of a turn was given to each, and the screws being of ¾ inch pitch, this advanced the building three-sixteenths inch for each bell stroke. As the screws had a working length of 12 inches, some fifty readjustments were required for the distance. A week of work was required. Two men were assigned for each tower screw, which had to give an average thrust of 15 tons each, and one man worked each of the other ten screws, and one foreman directed the turning. Thus nineteen men only were directly concerned in the moving.

Even the brick entrance porch was moved with the rest, although it had originally been decided to tear it down and rebuild it. The main body of the building varied from 29 to 50 feet deep. Taking this feature and the porch into consideration, it will be seen how very irregular the structure was in plan; yet, after the transfer, hardly a perceptible crack could be found in brickwork or interior finish.

THE PARK AVENUE IMPROVEMENT IN NEW YORK CITY—THE TEMPORARY DRAWBRIDGE ON THE HARLEM RIVER.

Lubrication.

In a paper on lubrication, read before the Birmingham Association of Engineers, Mr. Railings the author mentioned the following as the requirements of a good lubricant: (*a*) It should be thick enough to keep a constant film between the two surfaces to which it acts as a separator; (*b*) it should be as thin as possible consistent with the first requirements; (*c*) it should be a good conductor of heat; (*d*) it should contain nothing that will act chemically upon the bearing it lubricates; (*e*) it should be difficult of evaporation and decomposition. Sperm oil, when it is sperm oil, is one of the best lubricants, but it is dear. For surface working at low speeds and heavy pressure, graphite, soapstone, tallow, and grease are recommended. For high speed and heavy pressures, sperm, castor, and heavy mineral oils are suitable. For light pressures and high speeds, sperm, petroleum, olive, rape, and cotton oils may be used with advantage, and for steam cylinders heavy mineral oils will be advisable.

ITALY has 4,800,000 lemon trees, which produce about 1,260,000,000 lemons annually.

THE CENTRIFUGAL BOWLING ALLEY.

A. E. BEACH.

One of the most entertaining as well as hygienic amusements is bowling. The exertion required to project the balls involves nearly all of the muscular system of the thorax. The arms, lungs, heart, back, and loins all respond to the movement, and the play is at once healthful and invigorating. For young people of both sexes it is particularly beneficial. It develops the limbs and chest, and imparts grace and flexibility to the body. But the practice of bowling is at present very limited, owing not only to the cost of the appurtenances, but chiefly to the great length of the floor space required. A first-class single bowling alley costs $350, and requires a flooring 85 feet long and 6 feet wide. The practice of bowling at home in ordinary dwellings is, therefore, out of the question. Special houses for bowling are required, except when the cellars or basements of large buildings, such as clubs or hotels, are made available.

The object of the present design is to modify the longitudinal dimensions of the bowling alley and adapt it, if possible, to the requirements of domestic life, in short, to make a bowling alley that may be used in the play room or other apartment of almost any good sized dwelling house. Instead of the long straight floor, a circular cycloidal pathway for the balls is provided, the track being thus, as it were, bunched up in the air, instead of being extended out in a straight line as a floor. This new system is illustrated in our engravings.

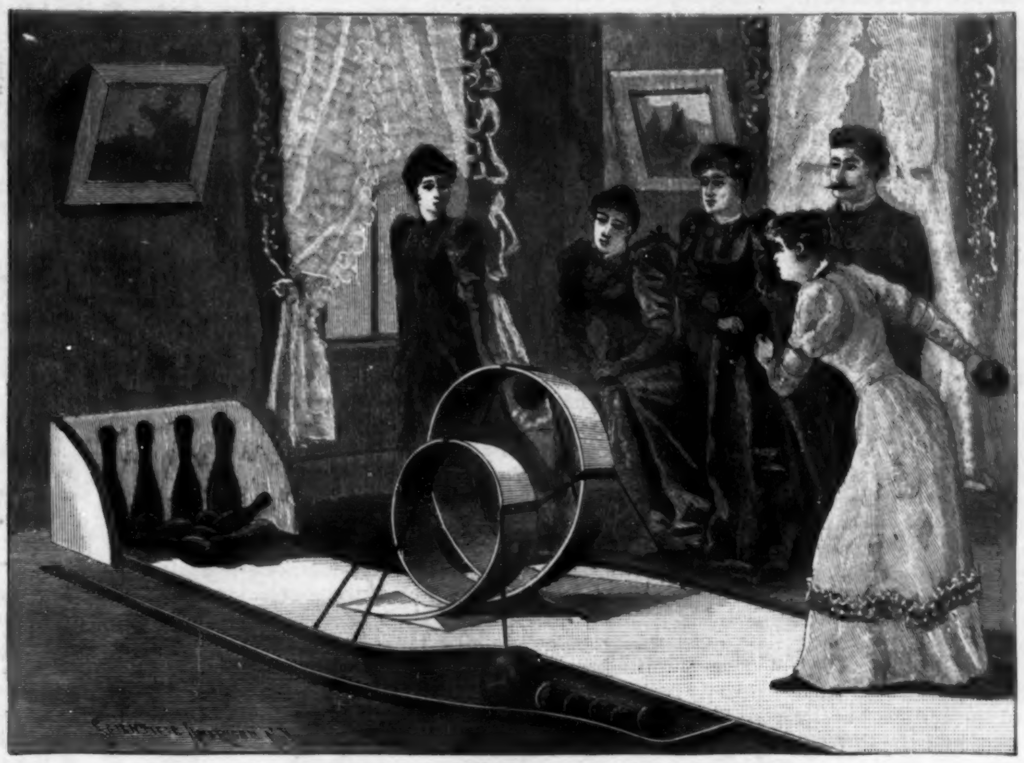


Fig. 1.—THE CENTRIFUGAL BOWLING ALLEY.

Fig. 1 shows a bowling alley in which the path for the ball is arranged, in part, in spiral form. The ball is projected in the usual manner, rolls up and down through the spiral path, and then proceeds straight toward the pins at the opposite end of the room.

Fig. 2 shows a similar form of path with a return spiral added, so that the ball, after traversing the spiral path, returns toward the thrower and strikes the pins at one side, as represented.

The balls are kept within the spiral pathway by centrifugal force, the principle of operation being the same as the well known spiral railway, in which the car sticks to the track, and the passengers keep their seats, although the car flies along bottom upward.

Fig. 2.—THE CENTRIFUGAL BOWLING ALLEY WITH RETURN SPIRAL.

A New Product for Oiling Wool.

Mr. E. Godschau, a Frenchman, has patented a substitute for oil, to be used instead of oleine, olive oil, or other fatty matters in the oiling of wool. It consists of a mixture of soap water, glycerine, and carbonate of potassium. Soap is used because it imparts viscosity to the water and facilitates or promotes the adherence of the fibers to be treated to each other. Glycerine is a neutral body, soluble, in any proportion, in water. It dissolves the soap and deliquescent salts and maintains in the wool the necessary moisture, while it is being made into yarn. Glycerine remains fluid at the lowest temperature, does not evaporate on exposure to the air, and is not susceptible to rancidity or spontaneous combustion. By its employment, the fibers of the wool are moistened, lubricated, and rendered flexible and supple, without being charged with grease, and they are preserved from all change. These qualities facilitate the carding, combing and spinning of the wool. Carbonate of potassium is a deliquescent salt, and is added to further maintain a state of humidity in the fibers, while it also increases the unctuousness of the mixture and renders it more consistent. Being very soluble in either water or glycerine, it renders the mixture more soluble in water at ordinary temperatures and gives it a greater homogenity. It also prevents any remaining traces of mordants, having insoluble bases, from forming insoluble soaps with the soluble soap contained in the new substance, by transforming them into soluble carbonates.

The constituent parts should be employed in the following proportions: Fifteen parts of soap, twenty-four of glycerine, and five of carbonate of potassium for each hundred parts of water; but these proportions may be considerably varied, without departing from the spirit of the invention.

Among the advantages to be gained by its adoption are increased solubility in water at ordinary temperatures, the immediate impregnation of the fibers, and a saving in cost, as compared with the usual oil or grease. In the fulling operations, an economy of time is effected and alkaline substances and soap are also saved, as there is no necessity for extracting surplus grease or oil. The fibers or the cloth manufactured from them are capable of receiving brighter and fresher colors and are much improved to the feel. As there are no unsaponified portions of greasy matter employed in the oiling, there will exist no irregularities in color after dyeing, thus obviating any necessity for the repetition of the operation. The risks of fire and disagreeable smells are very much reduced. In use, the compound of glycerine soap and carbonate of potassium is dissolved in water at ordinary temperatures, and the wool is treated with it in the same manner as with the oily matters commonly employed.—*Textile Industries.*

Mortality from Tuberculosis.

M. Lagneau, from a comparison of many European statistics, has tabulated these results:

1. That the occupations which expose the person to *dust*, whatever they are, predispose to tuberculosis to a remarkable degree; *e. g.*, according to Swiss statistics, 10 per cent of stone cutters die of it.

2. Those who follow sedentary occupations are more disposed to tuberculosis than others. According to English and Italian statistics, of students and young clergymen, 459 in 1,000 die of tuberculosis.

3. Printers in England and lithographers in Italy to the number of 300 to 400 in 1,000 die of it.

4. On the other hand, people who live in the open air have almost entire immunity from the disease; this is the case with shepherds, farmers, and boatmen; only one or two in 1,000 having it, according to Swiss records.

M. Lagneau has also examined the subject with reference to the effect of habitat and density of population.

In France, sanitary statistics in regard to 662 cities show that the more the population is crowded, the more seriously are they attacked by tuberculosis. In 95 towns of less than 5,000 inhabitants, only 181 in 1,000 die from pulmonary affections; 33 towns with from 5,000 to 10,000 people lose 216 in 1,000; 127 towns with 10,000 to 20,000, 271 in 1,000; 50 towns with 20,000 to 30,000, 288 in 1,000; 11 towns with 100,000 to 430,000, 363 in 1,000; Paris with its 2,424,705, 490 in 1,000.

The progression is regular and needs no commentary; but it is a question if contagion, increased as its dangers are in crowded localities, is not sufficient to account for the statistics. Contagion as the first cause, aggravated by the profession and the habitat as accessory causes. These seem to be the summing up of science upon the subject.—*Revue Scientifique.*

A Connecticut River Sea Serpent.

Austin Rice, of East Deerfield, a plain, unimaginative farmer, who for nearly fifty of the seventy years of his life has resided in his quiet home on the banks of the Connecticut River, said a few days ago: "I was near the bridge, a little over a week ago, when I heard what seemed to me like a grunt followed by a splash. I looked into the river, and, not more than twenty-five feet away, I saw a big snake.

"Its head was out of water, and its body raised some six or seven feet. At the neck the snake was about as large as a man's leg at the thigh, and the body was about as large as an ordinary stovepipe. His eyes were as large as those of a horse, and his mouth, which was open, was nearly a foot across. The color of his body was black, and a white stripe around his mouth extended down to his belly. I followed the snake, trying to keep alongside of him. At one place he started for the bank, and I started away from it. His power of locomotion was so strong that he had no trouble in keeping still in the river against the current. Whan he got alongside a boathouse where some boys were hammering, he heard the noise and raised himself about ten feet into the air and then fell back into the water and disappeared."

Mr. Rice's reputation for veracity among his neighbors and acquaintances is good.—*Boston Herald.*

HORSES sleep with one ear pointed to the front; but why, no man can tell.

Poisons on Fruit.

There has been much discussion of late concerning the danger of poisoning from eating fruit which has been sprayed with salts of copper or arsenic to destroy insects or fungi upon the plant.

It is stated that experiments have been carried on for two years at the Michigan Agricultural College with a view of finding out the truth in the matter.

The important question is, Do the poisons penetrate the skin of the fruit? The tests have shown that copper sulphate has passed into the body of the pear, though more of the solution remained upon the skin. If this peel is not a protection, what can be said of the thinner skins, like those of the plum, the cherry, berries, etc.? Dr. Kedzie, who made the analyses, says that horticulturists often use much larger quantities of the poisonous solutions than are necessary to destroy the life of the fungi; one-half or even a third of the quantity generally used would be enough.

It is not safe to eat fruit which has been sprayed with any poisonous salts, for while the poison received into the system from one pound might not be harmful, if no more were taken, repeating the doses may in time result in slow poisoning.

And how are people in the cities to know whether or not their fruit has been sprayed?

AN IMPROVED BOILER TUBE EXPANDER.

According to this improvement, a hub rotating on a tapering central mandrel carries small steel rollers which bear against the inner periphery of the tube, a stop collar arranged about the mandrel outside the hub bearing against the tube sheet and serving as a guide for the mandrel when rotated. The invention has been patented by Mr. Henry Strecker, of Marietta, Ohio. At three points on the periphery of the hub there are recesses cut through to the interior bore, and holding rectangular boxes open at the top and bottom, the boxes being of somewhat tapering form, and having outer faces smaller than the holes in the hub in which they play. The boxes are inserted from the interior bore, and projected outwardly, but by reason of their taper will not pass entirely through the holes, preventing them from ever falling through the hub away from the mandrel. In each of the boxes is loosely held a steel roller, the rollers rotating in contact with the inner periphery of the tube when the mandrel is turned, but without falling out, their outer faces bearing directly against the tube and their inner faces against the mandrel. The construction permits the largest possible opening in the hub, so that a maximum range of expanding movement for the rollers is obtained. A washer and nut on the small end of the mandrel prevents the hub and stop collar from slipping entirely off the mandrel when not in use.

STRECKER'S BOILER TUBE EXPANDER.

Coast Defense.*

Works of coast defense are required (1) to protect our cities from distant bombardment from the ocean; (2) to bar the passage of fleets through narrow channels leading to important places; (3) to forbid the occupation of harbors useful to an enemy; and (4) to co operate with naval coast defenders in closing wide entrances of value leading to important landlocked bays or sounds.

In selecting the position for the works, local topography often exerts a governing influence. The best conditions are where the ground rises some 100 to 200 feet above the water; where a wide development is offered to the land guns, and a contracted field of battle to the enemy; where the depth, tidal oscillation, and currents are moderate, thus permitting the use of submarine mines as an effective obstruction, and where the soil and sanitary conditions are suitable to the objects intended.

To forbid to an enemy the occupation of a harbor useful for his purposes is a simple operation. It only requires a few modern mortars in a battery suitably designed to facilitate accuracy of fire and well protected against the operations of landing parties.

In the matter of mortar or high-angled fire it is believed that American ideas are in advance of any existing European constructions, although indications are not lacking that the subject is now attracting serious attention abroad. We have adopted a single caliber, 12 inches, in order to secure sufficient weight in the projectile to insure deck penetration, and sufficient capacity for large charges of high explosives. Recent experiments at Sandy Hook, as well as reports from Europe, induce the belief that either of two varieties of high explosive may be safely used in charges as large as 100 pounds in high-angled fire, and that ranges of at least 5 miles may be employed with sufficient precision to render the service appalling to shipping. The greater the distance of the vessel from this kind of battery, the greater her danger if struck.

Rapid-fire guns, chiefly of 12 centimeters (4·72 inches) caliber, are favored for sweeping the mined fields and water approaches. They will be mounted on the balanced pillar principle, so that perfect concealment in pits will be practicable until they are brought into action.

Submarine mines will be used to obstruct the passage of vessels past the batteries. They will not be restricted to single lines, through which it is too easy to countermine, but will be distributed over considerable lengths of the channel where they can be covered by a heavy fire of flanking guns. The mines are of the electric type, exploded automatically at contact with the vessel or by judgment at the will of the operator. Ground mines of cast iron are preferred for shallow water, not exceeding 30 feet, and buoyant mines of steel, spherical in form, for deeper channels. The size of the latter is adjusted to furnish the requisite buoyancy, which varies with the depth and strength of the currents. Experience has shown that where the depth exceeds about 100 feet and the velocity of the current is over 7 feet per second, the size becomes too great to admit of successful working. Tidal oscillations greater than 10 feet introduce serious difficulties in obstructing a channel by mines, but it fortunately happens that at none of our important ports is this range exceeded. Where more than one passage exists, channels not needed for our vessels will be closed by self-acting mines dangerous alike to all comers. A pattern perfectly safe to plant, self-destructive if set adrift, and exceedingly difficult to remove has been adopted.

Firing mines by judgment meets with but little favor in our service. The destructive range increases even less rapidly than the square root of the charge, and unless wasteful quantities of the explosive are used, the difficulty of determining the exact relative position of the mine and the ship will lead to failures, especially in the case of buoyant mines which swing considerably with the tide. By night and in fogs a judgment system would be worthless. Hence many small charges well distributed and exploded automatically at the shock of the vessel are preferred. By the use of electricity as the igniting agent, such mines will be harmless to our own vessels. The usual charge for contact mines is 100 pounds, and explosive gelatine or dynamite No. 1 is preferred for service. The electric fuse contains 24 grains of mercuric fulminate, and is ignited by a current of half an ampere. Mines are usually designed to be spaced at 100 feet apart, thus allowing for moderate errors of planting, since they are not mutually destructive at distances of about 40 feet. A 500 pound countermine works no injury at a range of 80 feet. It is considered that a channel defended upon the system adopted cannot be traversed with impunity until cleared by the operations of the hostile fleet, and the extreme difficulty of effecting this object under the close fire of the land guns will render such obstructions far more formidable than any other kind now known.

Space is lacking to consider, except in a very general manner, the engineering details of the coast batteries now under construction to receive our modern armament. Magazine accommodation for 200 rounds, of which at least 100 rounds will be stored in the immediate vicinity of the pieces, is provided for all high power guns. Shells will be stored loaded, but without the fuses, and the propelling charges will be kept in service cartridge bags protected by waterproof zinc cases. No handling of loose powder will thus be needed in the magazines. This condition is demanded by reason of the immense amounts of powder required by modern high power guns. Thus for 200 rounds the amount called for by an eight inch gun is 13 tons; by a 10 inch gun, 25 tons; and by a 12 inch gun, 45 tons.

As no funds have thus far been made available for the construction of armored land defenses, no definite decision as to the kind of armor to be adopted has been made. The matter is held in reserve to benefit by the latest developments. It is hardly probable, however, that the immense expense of the new types of ship armor will be demanded, especially as on land weight is rather an advantage than otherwise.

The batteries under construction are protected by earth and concrete. With a view to deflecting the projectiles, and to reducing cost, as many bowlders or large masses of rock are incorporated in the latter as is consistent with the formation of a solid monolith. The rule has been adopted that the magazine cover on any probable path of a projectile fired from the larger high power guns should be 40 feet of such concrete and 10 feet of sand, or their equivalents—2 feet of sand being regarded as the equivalent of 1 foot of concrete. Near the surface the full thickness of concrete is used, and its exterior face is given a slope of 1 on 1 for the purpose of deflecting the shot. For parapets a breast height wall of 25 feet of concrete with exterior covering of earth sufficient to fill out to the plane of magazine cover is adopted. This total protection corresponds to a thickness of about 70 feet of sand.

The new system of coast defense is fairly inaugurated, and will be prosecuted as rapidly as Congress provides the funds. Mortar batteries are now under construction at both entrances to New York Harbor, at Boston, and at San Francisco. A gun lift battery for two 12 inch guns has been constructed and successfully tested at Sandy Hook. Disappearing gun batteries are completed or under construction at Portland, Boston, both entrances to New York Harbor, Washington, Hampton Roads, and San Francisco. Mining casemates are built with their cable galleries at all the most important harbors, and a fair supply of the mines and their accessories are in readiness for use.

* Abstracts from a paper by Brevet Brig. Gen. Henry L. Abbott, U. S. Army, Colonel, Corps of Engineers, read before the International Congress of Engineers at Chicago, and published in the *Journal of the Military Service Institution of the United States*, by permission of Major Clifton Comly, Chairman of the Division of Military Engineering.

RIGHTHANDEDNESS AND LEFTHANDEDNESS OF SIGHT.

Are you righthanded or lefthanded of sight? At present, in hunting and in pigeon shooting, good marksmen generally fire with both eyes open. How can they aim, that is to say, place the eyes, the two extremities of the barrel and the target upon the same straight line? It is possible to put the gun sight, the target, and a single one of the two eyes upon the same line; but to do this with both eyes is as difficult as it is to put the foot of the large arm of a cross and the two extremities of its small arms or the three angles of a triangle in a straight line. And yet these marksmen assure you that they aim with both eyes, and, in fact, at the moment of firing, they have both open; but they aim often with one eye only, without being aware of it.

In order to convince yourself of this, take a piece of paper or cardboard or a playing or visiting card, and, with a sharp pencil, make a hole in it of the diameter of the pencil. Place this card at 30, 40, or more centimeters from your eyes and at 10, 15, 20, or more from any point upon say a table or wall (Fig. 1). This point will represent the target, and the hole in the card will be the sight. With both eyes open, look at the point in placing the card, or rather the aperture, between such point and your eyes, and, while you hold it, first close one eye, and then open it and close the other without changing the position of the card. Now, you will at once perceive that you see the point sighted with but one of your eyes, unless the perforated card be shifted; that is to say, the aperture in the card and point sighted are in a straight line with but one of your eyes, without your in the least mistrusting it, since you sighted with both eyes open. The same thing happens to the marksman who aims with both eyes; one eye alone operates usefully for aiming.

Instead of performing this experiment with a perforated card, it can be made with the hand. To this effect, place the end of one of your fingers in a straight line with any more or less distant point and your eye, both eyes being open. Afterward close your eyes alternately, and you will become aware of this fact, viz., that with one of your eyes you will see your finger tip and the point that is sighted upon the same straight line, and that with the other there will be a wide space between such point and the extremity of your finger. Many of those who shoot with the two eyes open are excellent marksmen, and many of those who formerly closed one eye have changed system, having found that the advantages of this method are real. The object is seen better, the distance is calculated better, and, at the moment of pulling the trigger, one avoids the muscular effort necessary to close the eye, and which has required practice. Children do not succeed in it upon the first trial, and without grimaces. Many grown people cannot close a single one of their eyes or can close only one of them—the right or the left.

In England, as we know, where first-class marksmen are very numerous, and where guns of remarkable precision are made, gunsmiths are not ignorant of the fact that the marksmen who aim with both eyes open make use effectively of but one eye for pointing; but they have, it appears, observed that this eye in some is the right one and in some others the left; that is to say, there is righthandedness and lefthandedness for the sight as well as for the hands. We say here *for the sight*, as we do not intend to speak of those who cannot close the right eye or the left eye, or of those who are blind in one eye or the other, or of those whose right eye or left eye sees objects more distinctly than its mate.

Those who are blind in the right eye might, if need be, shoulder to the left or slightly modify the position of the head or weapon. Still, no one is ignorant of the fact that there exist special guns for those who are

blind in this eye and who wish to shoulder to the right like every one else, without in anywise changing the ordinary position of the body (Fig. 2). In such guns the axes of the breech and barrel are in two different parallel planes, in order that the barrel and the left eye may be easily placed upon the same line, while the back of the weapon is to the right. The difference that separates these two planes is that which exists between the centers of the right and left eye.

One may deduce from this fact how important it is to a gunsmith who is to construct a weapon of value for a marksman who aims with both eyes open, to know whether his customer's sight is righthanded or

Fig. 1.—EXPERIMENT TO SHOW WHETHER A PERSON'S SIGHT IS RIGHT OR LEFT HANDED.

lefthanded, just as it is important, before placing him upon a railway, to know whether the engineer of a locomotive, who, by his calling, ought to distinguish red and green, is or is not affected with daltonism. The majority of men do not confound these two colors, and so, too, almost all hunters have righthanded sight, but in both cases it is prudent and wise to know positively what to depend upon. So good gunsmiths, it seems, submit the person who orders a gun of them upon measurement to a careful examination, in order that the weapon may be as well adapted as possible to the proportions and habitudes of the future owner, and they do not neglect to ascertain whether the marksman's sight is lefthanded or righthanded, a circumstance of which he is generally ignorant. For such verification they employ the perforated card that we mentioned at the beginning of this article.

Do these gunsmiths obtain other information from such experiment? We do not know. The object of this article is not a study (which, however, would be interesting) of the advantages and inconveniences of firing with one or both eyes open with sporting guns or weapons of war. We shall add solely, apropos of this, that an old soldier has assured us that he has spent several days in the guard house because he did not succeed in closing the left eye at the moment of taking aim. This fact assuredly should not be isolated, and I follow it up now to ask whether it would not be more rational to teach sharpshooters to take aim, like many of the best civil marksmen, with both eyes open—a method that would cause the avoidance by soldiers of efforts, grimaces and perhaps punishment, even.

Moreover, marksmen are not the only ones who, having to make use of a single eye at a time, operate with both eyes open and even for very delicate work. Watchmakers and others who have made continuous use of the simple or compound microscope finally no longer close the eye with which they are not looking, and this, without causing any inconvenience, does away with certain useless effort and fatigue. Have such questions already been treated of in special works on hunting and shooting or in treatises on optics and ophthalmology? We do not know. It was but a short time ago that we were ignorant of the facts of which we have just spoken, and, in our turn, we point them out to the numerous persons who have never asked themselves how it is possible that one can succeed in aiming well with both eyes open.

We believe, then, that it may be established without fear of error (1) that it is possible to use consciously or instinctively a single eye while both eyes are open, and that such eye may be either the right or the left; (2) that there is a righthandedness and lefthandedness of sight; (3) that a person may not know whether his sight is right or left handed; and (4) that the eye upon which the attention and will is fixed—in other words, the one with which a person looks—is the one with which he sees, even when both are open. This latter fact finds a confirmation in the workers with the microscope of whom we have above spoken; and we have verified it by the following easily tried experiment:

Place in front of your eyes two paper or cardboard tubes from 3 to 4 centimeters in diameter, and hold them as you would an opera or field glass, but in such a way that they shall form with each other an angle of say 20° or 30°, as shown in Fig. 3. Direct the two tubes at two points, say two open books or the two somewhat widely spaced columns of a newspaper situated at a few centimeters from the extremities of the tubes that would carry the objectives if they were telescopes. You will then observe that it is very easy and in nowise fatiguing to read with the eye to which you give your attention, while the other sees nothing, although it remains open, and it is of little consequence whether it be the right or the left.

If, at the moment in which one of your eyes is reading or looking, you remove the tube that corresponds to the one that is not looking, you will continue to see only with the eye that is looking, although the other be open. This is the case with workers with the microscope.

The sight is an admirable faculty that focuses or regulates itself without the aid of our will, according as the object to be seen is more or less distant, and according as it operates in a dark or highly illuminated medium, but it may make use of but one of the two windows at its disposal, according to the requirements of vision. These operations of the sight are effected without our being able to suspect them.

Philosophers have discussed (and what have they not discussed ?) whether there are things absolutely indifferent. Newton, we believe, thought that there were things indifferent even to the Creator. The universe, said he, had to revolve to the right or to the left. Now, at the moment of the creation it was indifferent to God whether his work began to turn toward one or the other of these two sides.

It has also been asked whether the preferred use of the right hand and the right side is innate, spontaneous, or whether it is the result of atavism and education; and, to look at things merely superficially, it would seem as if one might find some argument or other for this question in the fact of the greater or less number of cases of righthandedness or lefthandedness of sight. It would seem, in fact, as if the sight has not undergone the influence of education, in a large number of individuals at least, since they do not know even whether they are right or left handed.

But, in a closer examination, we observe that the influence of the hand over the eye or of the eye over the hand had to exist, and that it is not easy to establish in a peremptory and convincing manner where the primordial influence is found—whether it is in the eye or in the hand.

As for us, we are led to believe that there are more right than left handednesses of sight, because the right eye has undergone the influence of the secular education of the right hand and right side. We observe, in fact, that, for centuries, marksmen, for example, have been taught to assume attitudes in which this side has the most important role. Weapons have changed, but the position of the body has been preserved through the ages.

In shooting, the left arm serves only as a support; it is the right that bends the bow and sets free the string and arrow, and it is that, too, that pulls the trigger of the crossbow or gun while the head inclines to the right and one sights with the right eye. The same is the case with taking aim with a stone. The man or child raises the projectile to the height of the eyes, bends his head slightly to the right, places the right eye, the right hand and the object at which he is going to fire the stone upon the same line, after moving his left arm to the rear. The left arm plays a role, but an instinctive one, of counterbalance, of counterpoise.

But, again, is it the right hand that obeys the right eye or *vice versa*? Does the right hand owe its advantages to education and atavism, or is it rather trained

Fig. 3.—READING AT WILL WITH THE RIGHT OR LEFT EYE, BOTH EYES BEING OPEN.

unconsciously by the greater innate aptitude of the right eye for seeing, sighting and fixing? Then, it would be the sight that has commanded the position of the body and hand in the cases that we have just mentioned.

We shall terminate this article with a few statistics. Out of twenty or twenty-five persons, we have found two who had lefthanded sight—a lady who, nevertheless, was capable of handling a sporting rifle and who used it in closing the left eye for aiming, and a shortsighted monk. After explaining to the latter what it was a question of, we asked him if he thought his sight was right or left handed. He answered: "Righthanded, assuredly, since I see better with the right eye than with the left." The experiment with the perforated card proved to us that he was deceived.

Have lefthanded persons lefthanded sight, also? Are they lefthanded in the two organs in the same numerical proportion as righthanded persons? The experiment is easily made, but we have not attempted it, for want of subjects.—*La Nature.*

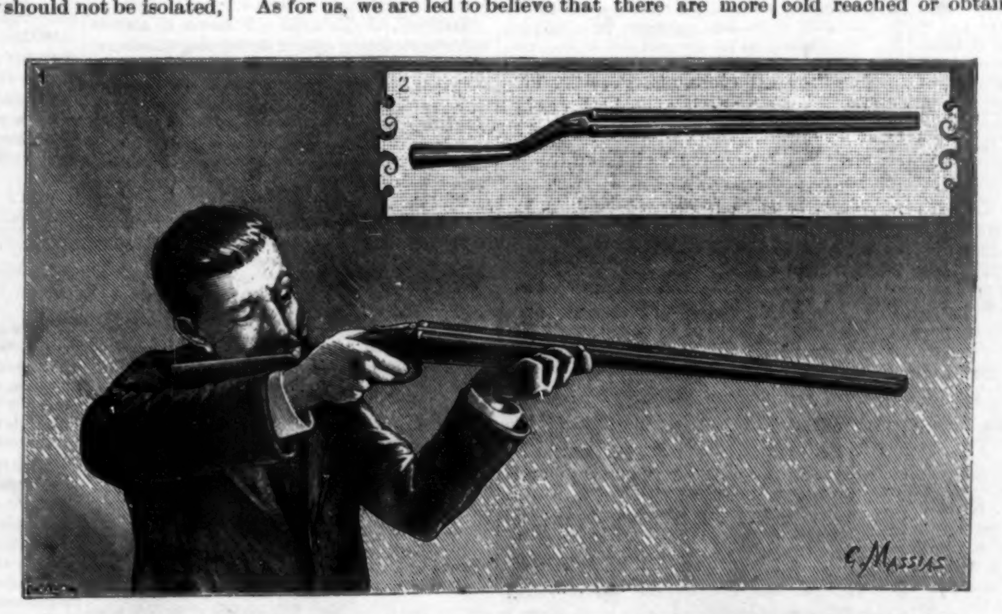


Fig. 2.—1. MARKSMAN SHOULDERING TO THE RIGHT AND TAKING SIGHT WITH THE LEFT EYE. 2. SPECIAL GUN FOR THOSE WHOSE SIGHT IS LEFTHANDED.

Experiments in Freezing Alcohol.

The success attending Prof. Dewar's experiments in the freezing of absolute alcohol has a peculiar interest, in view of the fact that 200° C. was the utmost limit of cold reached or obtained by man, viz., by the use of liquid oxygen. Prof. Dewar allowed some liquid ethylene to flow through a brass tube surrounded by solid carbonic acid and ether, and, when this cooled, it was passed into a large test tube, in the middle of which was placed a glass tube, with a flattened bulb at the end, the bulb being full of absolute alcohol. The evaporation of the ethylene was then accelerated by the use of the air pump, and the alcohol was frozen into a mass as clear and transparent as crystal. The tube containing it was turned bottom upward, and as it melted it assumed exactly the consistence of glycerine, flowing in a sluggish way down the sides of the tube. Ether requires less cold than alcohol to freeze it, and in several of Prof. Dewar's experiments ether ice formed on the sides of the glass vessels. Besides this, the warm air of the theater was constantly condensing as snow or hoar frost on some of the vessels used in the experiments, and the chief difficulty of the occasion was the projecting of the experiments on the screen by the electric light, so that all present might see what was taking place.

WITH an opera glass Gale's comet may be seen about May 10 in the constellation of Leo Minor, just above the Sickle.

RECENTLY PATENTED INVENTIONS.

Engineering.

FILLING BLAST FURNACES.—Thomas F. Witherbee, Port Henry, N. Y. This inventor has devised an improved charging apparatus designed to properly fill the stack, even when very finely divided ore is to be treated, such as magnetically concentrated iron ores. The apparatus comprises a movable bell having a central aperture, through which is adapted to pass a spreading bell, while a fixed bell is adapted to close the central aperture of the movable bell and receive the spreading bell. A great variety of charging combinations can thereby be formed to permit of placing the materials as desired in the stack.

COAL CHUTE REGULATOR.—John F. Schmadeke, Brooklyn, N. Y. This is an apparatus adapted to operate automatically in connection with the usual elevator to throw mechanism into gear by the filling of the chute, which shall wind up a cable on a drum and open the chute doors, the mechanism being arranged so that it will work in a converse way to close the doors as the chute becomes empty. The invention relates to coal chutes filled by elevators, and from which coal is withdrawn for use, where it is desirable to keep the chutes full to prevent the breaking of the coal by dropping to the chute bottom.

Railway Appliances.

CAR COUPLING.—John Cochran, Jr., Collins, Mo. According to this invention, swinging bails are arranged, one in rear of the other, rods or bars which connect the bails being extended in advance of them and supporting an inclined link guide. The bails form swinging parallel carriers, which operate in parallel lines and swing the guide back and forth without changing its angle to the horizontal, so that it will be presented properly to receive the approaching link. The construction is simple, and by means of the improvement the cars may be coupled from the side or top, without need of the trainmen going between the cars.

Mechanical.

SAW HANDLE.—Azell B. Van Campen, Raymond, Cal. This is an adjustable handle for long saws, such as are used for cutting up logs and timbers, being adaptable to any saw of this class, and designed to facilitate the operation of sawing by permitting of greater freedom of movement of the hands. The invention consists of a revoluble handle for the end of the saw, with a handle for the back of the saw and a hooked bolt for clamping the two handles to the saw.

METALLIC PACKING.—Frederick A. Ives, Grant's Pass, Oregon. The proper packing of piston rods, valve stems, etc., is the more especial object of this invention, which provides a packing consisting of a coil having uncut ends forming steam-tight bearing surfaces. The packing is simply made and is readily applicable to large or small stuffing boxes. On one uncut end of the coil is a pin engaging a correspondingly shaped recess in the bottom of the casing, a similar pin on the other end engaging a recess on the inner face of the gland, fitted loosely on the piston rod or valve stem.

SEWING MACHINE NEEDLE BAR.—Henry A. Dodge, Boston, and William T. Richards, Newton, Mass. This invention provides the face plate with gibs so arranged as to effectually take up the wear of the needle bar and prevent it from wearing in the face of the plate. The gibs are so made that they will be interchangeable, right or left, and the surfaces adapted for engagement with the needle bar are hardened to resist wear.

STONE CARVING MACHINE.—Antonio Zanardo, New York City. In this machine a table has movement in a bed and a tool carriage is held to revolve upon the table, there being a plate adjustably located in the bed and adjusting devices, whereby the bed plate may be set eccentric to the carriage. The tool may be given any required angle to produce a desired undercut, and may be regulated to carve various embossed or intaglio figures upon the same or different planes. The setting of the tool is quickly and easily effected, and with the machine circles and ovals may be made as desired, as well as the carving of any design, even to a figure of a human being in relief.

Agricultural.

MOWING MACHINE ATTACHMENT.—William L. Hay and Robert L. Johnston, Franklin, Tenn. This is a gathering attachment comprising side supports detachably secured on the sickle portion of the mower frame, a receiving platform and a revolving rake, over the rear end of which is journaled a revolving discharging rake. The improvement is especially designed to facilitate the gathering and piling up of seed clover as it is cut by the mower. The attachment may be detachably connected with any of the mowing machines now in general use, and it is simple in construction and easily manipulated.

Miscellaneous.

HOUSE MAIL BOX.—Edwin F. Kinsey, Washington, D. C. This box is to be attached near the front door of a building, and is so arranged as to indicate to the carrier when mail is deposited in it, and to indicate by a signal to the occupants of the house when the carrier places any mail in the box. The box is also arranged to effect the purchase of stamps, stamped envelopes, and postal cards from the carrier, in definite quantities, and the making of change therefor, without risk of loss of money or mail.

SOLDIER'S FIELD EQUIPMENT.—George H. Palmer, U. S. army. This invention comprises a half shelter canvas tent, to be united with a like half shelter tent, and carried by being placed around the soldier's bedding and placed in a roll over the shoulders and across the body, in combination with a valise similarly carried, to hold ammunition, clothing, and toilet articles. By the novel construction and by certain straps and attachments, both the valise and half tent roll are held in place on the shoulders, the body and arms being unconfined and free, and the weight being well distributed, while the whole is so made that the wearer may easily put it on or off.

PIN FOR ATTACHING FLOWERS TO DRESSES.—Edward W. Stifel, Wheeling, West Va. This pin is made of a single piece of wire bent and twisted about itself to form a body terminating in two closed loops, through which a ribbon may be passed, there being a projecting portion adjacent to each loop, and a spring pin and hook at the ends of the projecting portions. The pin will securely hold in place flowers in spray or other shape without injury to costumes or dresses.

Designs.

CARPET.—William F. Brown, Newark, N. J. The body of this design is decorated with flowers of the rose and daisy type, with foliage in festoon arrangement, and the border has differently arranged but corresponding festoons of flowers and foliage.

HANDLE FOR SPOONS, ETC.—Charles Osborne, New York City. A foliated figure at the top of this handle represents centrally a cluster of grapes. Near the center the handle is nearly circular in cross section, while near the bowl it is nearly rectangular, with inturned leaf-like figures on the obverse and reverse, there being flowing tendrils on the back of the bowl.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

SCIENTIFIC AMERICAN BUILDING EDITION.

MAY, 1894.—(No. 103.)

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1. Elegant plate in colors showing a handsome residence recently erected for William H. Bartlett, Esq., at Evanston, Ill. Two perspective views and floor plans. Mr. J. L. Silsbee, architect, Chicago, Ill. A very picturesque design.
2. Plate in colors showing a cottage at Mt. Vernon, N. Y., recently completed for E. J. Walther, Esq. Two perspective views and floor plans. Mr. L. H. Lucas, architect, Mt. Vernon, N. Y. An excellent design.
3. Cottage at Morgan Park, Ill., recently erected for G. F. Patterson, Esq., at a cost of $3,000 complete. Two perspective views and floor plans. Mr. H. H. Waterman, architect, Chicago, Ill.
4. A summer house at Southampton, Long Island, N. Y., recently completed for H. M. Day, Esq. Two perspective views and floor plans. A model design. Messrs. G. E. Harney & W. S. Purdy, architects, New York.
5. A residence at Portchester, N. Y., recently erected for Walter S. Haviland, Esq. Two perspective views and floor plans. A very pleasing design. Mr. Louis Mertz, architect, Portchester, N. Y.
6. Floor plans, interior view, and two perspectives of a residence recently completed at Hackensack, N. J., for George A. Vroom, Esq. An excellent design and unique plan. Cost complete $6,950. Mr. Christopher Meyer, architect, New York City.
7. The Barnum Institute of Science and History, of Bridgeport, Conn., donated by the late Phineas T. Barnum. A one-half page perspective view. Cost for building and grounds $100,000. A fine example of the Romanesque style of architecture.
8. A residence at Stamford, Conn., recently erected for Oliver G. Fessenden, Esq., at a cost of $5,199. Two perspective views and floor plans. Mr. Wm. H. Day, architect, New York City. A very pleasing design.
9. A cottage of moderate cost recently completed for Hiram R. Smith, Esq., at Randall Park, Freeport, Long Island, N. Y. Cost complete $3,000. Two perspective views and floor plans. Mr. Wm. Raynor, Freeport, Long Island, N. Y., architect. A very attractive design.
10. "Otter Cottage," recently completed for Henry H. Adams, Esq., at Belle Haven Park, Greenwich, Conn. Mr. H. W. Howard, architect, Greenwich, Conn. An attractive design in the colonial style of architecture. Two perspective views and floor plans.
11. A colonial cottage at "The Bluffs," Mt. Vernon, N. Y., recently completed for E. A. Hunt, Esq. Two perspective views, an interior view and floor plans. Mr. Louis H. Lucas, architect, Mt. Vernon, N. Y.
12. Half-page engraving showing hall and staircase of a London dwelling.
13. Miscellaneous Contents: Clients' right of replicating design.—Shop and mill construction.—Seasoning oak.—Beautiful designs in parquetry work, illustrated.—The effect of fire on concrete.—Waterproof cellars.—Embossing wood.—Steel butt with ball-bearing washers, illustrated.—"The Holland" radiators, illustrated. — Graphite paint. — Sandpapering machines.—The Van Wagoner & Williams Hardware Company.—Window screens and screen doors.—Maple flooring.—The Pullman sash balance, illustrated.—Portland cement walks.—Subterranean London.—An alloy which adheres to glass.—A saw clamp and filing guide, illustrated.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6008) C. J. T. asks: I have a motor built after the Edison style, of the following dimensions: Drum armature core 6 inches long by 4⅝ diameters, wound with No. 16 B. & S., 32 sections, 6 convolutions in each section, two layers deep. Fields wound with 10 pounds No. 20 each. Want to rewind for a power circuit. The machine when run as a dynamo is 90 volts at 3,000 revolutions. I want to make a 110 volt machine of it and run at slower speed. Want to put in a fan circuit of about ten ⅙ horse power motors. A. You can probably use your machine safely as it is. To lower speed, increase the number of turns on the armature, or weaken the field. To keep high amperage you must use as low resistance as possible.

(6009) D. S. S. asks: 1. If a bell be rung inside a vessel exhausted of air, does it create any sound within said vessel, none being heard outside of same? A. There is no sound to be heard within the vessel, except by contact with the bell or with some object touching it. 2. If a transmitter were placed in the vessel with the bell and connected with a telephone outside, could we thereby hear the ringing of the bell? Has this experiment ever been tried? A. You could not hear it. We never heard of the experiment being tried.

(6010) E. A. S. says: One rule of mechanics is that a belt will always run to the highest point. What is the reason? A. The length of the belt edge on the high side as it is called, when shafts are not parallel or on the crown of pulleys, is always longer than at the low part or low side. The stretch of the belt to accommodate itself to this condition springs the straight part of the belt near its point of contact with the pulley toward the high part or crown and causes it to run in that direction; the effect being the same as if pushed by a shipper fork.

(6011) C. M. W. writes: In supplying blast to a cupola at an altitude of 9,000 feet, where the atmosphere is so much lighter than at sea level, will a pressure of 10 ounces furnish as much oxygen to support the flame under above conditions as a similar pressure at a lower altitude, or must the pressure be greater to compensate for difference in the rarefied condition of the air, owing to the altitude? A. The atmospheric pressure at 9,000 feet elevation is only about 10 pounds per square inch; 10 ounces pressure at the sea level only represents 6⅝ ounces at the above elevation and would probably be too weak in the blast as well as in the quantity of air supplied to the cupola. You will need 15 ounces pressure.

(6012) F. A. M. asks: 1. How can I make a dry battery? A. It is best to buy them. A mixture of plaster of Paris and chloride of zinc with chloride of ammonium and water in a zinc vessel with carbon pole in center will answer. 2. How can I make fluid in Edison-Lalande battery? What should I dissolve caustic potash in? A. Dissolve in water. 3. Please name a firm that manufactures batteries and supplies. A. Address Bunnell & Co., of this city.

(6013) R. E. W. asks: 1. Would cotton-covered wire (No. 36) answer nearly as well as silk-covered for a small induction coil? A. Yes. 2. I wish to make some good permanent magnets. What kind of steel should I order, and about what will it cost per pound? A. Use good quality Stubs or tool steel. 3. Will the inclosed sample of wire give good results on a telephone line of two miles? A. Yes. 4. What would be the objection to using a well to ground the end of a telephone line? A. None, unless you object to having the plate immersed in the well. Some slight corrosion will take place.

(6014) J. A. McN. asks: 1. How many cells Leclanche would I need to work a telephone system over about two miles of a circuit (transmitter and receiver being alike)? A. Use 4 cells. 2. Which is the best for such a line or shorter? A. Leclanche cells are as good as any. 3. Is a metallic circuit better than a ground circuit and does it take less battery? A. It is superior, but hardly saves battery. 4. A body weighs 100 pounds at the poles and 101 pounds at the equator. How is this computed? A. Your figures are wrong. A body is heavier at the pole than at the equator. The relative weights are calculated by the formula for centrifugal force.

(6015) F. H. asks: Can you give me a table, or tell me how it is ascertained, what by different given current, length of wire, etc., will be the attraction, in ounces or pounds, toward the core of a magnet? In other words, how can I find out what weight a magnet of any build can sustain? A. You will have to calculate the lines of force driven out at the poles through the armature. In S. P. Thompson's work on the "Electro-Magnet," $6, you will find excellent matter on this subject.

(6016) F. H. S. asks: Is it possible to reflect all of a ray of light from a transparent body? Will not refraction take place to some extent as long as the ray strikes the body? A. For the rear surface of every transparent body there is an angle of total reflection within which all light is reflected. This applies to rays of light which, having passed through the body, reach the other surface. There is no such angle for the front surface.

(6017) L. F. D. asks: Do telephone, telegraph and electric light companies run their cables in the same conduits (under ground)? If not, why? A. Generally not, in order to avoid induction and possibility of danger from leakage. 2. Please give a solution how to clean hard rubber? A. Wash with ammonia and water, polish with kerosene and rottenstone.

(6018) R. asks if a good tennis court could be made out of coal ashes. If so, the method of operation and whether the ashes would require sifting. A. Ashes alone would hardly answer. You might by sifting them and mixing with clay get a good surface.

(6019) J. D. asks (1) what size wire to use to wind motor No. 759 for 25 volts, and about what power will it develop? A. Wind with No. 21 or 22 wire. 2. How many storage batteries like described in SCIENTIFIC AMERICAN, and how many plates and what size, should be to run it about 12 or 15 hours, and how long will take to charge same? Will dynamo No. 600 charge them? A. Twelve to fifteen. The time of charging will depend on the current. The dynamo named will be larger than necessary.

(6020) A. B. R. asks if the simple electric motor in "Experimental Science" can be run to good advantage with the Edison-Lalande battery; if so, which type would be most advisable, and how many cells would be required to give about the same result as the plunge battery, suggested to run this motor? A. Yes. Use ten cells type Q.

(6021) E. L. A. writes: Where can I get a history of the calendar and all its changes? What day of the week was George Washington born? And in what year? (So recorded at that time.) Was 1700 a leap year under Julian calendar? To make my meaning plain on questions 2 and 3, I will state that I have examined different encyclopedias on the calendar and find that they do not agree in this. Washington's birthday is now generally celebrated as having occurred on February 11, 1732, and now called February 22, 1732, but the following quotation from Appleton's Encyclopedia puts a different phase on it: "The change from Julian to Gregorian reckoning was made by act of Parliament in Great Britain in September, 1752, the 3d being called the 14th. In England from the 14th century till the change in 1752 the legal year began at March 25. After the change was adopted in 1752, events which had occurred in January, February, and before March 25 of the old legal year would, according to the new arrangement, be recorded in the next subsequent year. Thus the revolution of 1688 occurred in February of that legal year, or as we should now say in February, 1689." If the above quotation from Appleton be the correct way of computing back dates, then, since under the Gregorian calendar we celebrate Washington's birth as having occurred on February 22, 1732, at the time he was born (Julian calendar) it must have been called February 11, 1731, Friday. Or if, according to Julian calendar, he was born on February 11, 1732, we should now, under the Gregorian calendar, celebrate his birth as having occurred on February 22, 1733, Sunday. Which is correct? A. There is no special history of the calendar. It is scattered in detached details in the encyclopedias and technical works. Probably the best account is detailed in the Dictionary of Science, Literature and Art, long since out of print, under the heads of calendar, year, cycles, and chronology. George Washington was born on Friday, the 11th day of February, 1732, historical time in England and the American

colonies. The historical or business year in England began on the first da of January as established by the Romans. The ecclesiastical calendar embracing the civil or legal year previous to 1752 began on the 25th of March, and events between the 1st of January and 25th of March were usually dated with both years, as February 11, 1731½. The date of Washington's birth was fixed in the colonies to correspond with the new regulation; 1700 was a leap year under the Julian calendar, but not under the Gregorian.

(6022) C. B. W. asks (1) if the motor described in SUPPLEMENT, No. 641, can be run from an alternating current. A. No. 2. If not, how must it be wound to run from an alternating current? A. See our SUPPLEMENT, Nos. 692, 717, 944, for alternating current motors. 3. What size wire should be used to have it run with 100 volts and 10 amperes? A. Use No. 28 wire on field and armature. 4. If I should make the field magnet on motor 641 twice as wide, which would be five inches, and the armature core twice as large, which would be four inches, and put twice the amount of wire on the machine, would it be twice as strong as described in the SUPPLEMENT? A. In general terms, doubling all the lineal dimensions gives sixty-four times the power. But as you only double a portion, you may expect four or five times the power. 5. Can the motor 641 be run from the Crowfoot gravity battery? A. Not satisfactorily.

(6023) I. R. writes: 1. Can a storage battery be charged from an alternating circuit of 50 volts? If so, will the current from the battery be direct? A. A storage battery cannot be charged from an alternating circuit. 2. What is the main difference between an alternating and direct current motor? A. Several kinds of alternating current motors have been invented. We have described several in our SUPPLEMENT, Nos. 692, 717, 944, to which we refer for their peculiarities. 3. Can a 1,200 volt continuous arc circuit be tapped in such a way as to get a current of 50 volts? A. There is no such thing as a current of 50 volts. By a shunt connection you can get such a potential difference. We advise you not to do it, as you expose yourself to great danger.

(6024) S. J. S. asks: How does the heat from the sun penetrate through the intense cold of the upper regions, and warm the surface of this planet? A. Heat is supposed to be a state of molecular motion or vibration conveyed through space in the medium of the luminiferous ether. A medium having no effect upon the progress of planetary bodies, yet capable of transmitting the pulsations of heat, light, magnetism and electricity. It is probable that heat does exist in space to a very low degree in its radiant form and only develops into active energy by resistance of planetary bodies to its vibratory transmission.

(6025) W. F. asks: 1. What per cent of power developed at power house is lost in transmitting for street car propulsion of the three following methods: Cable, electricity (trolley system) and compressed air? A. No exact figures can be given, except that under average conditions the electric road may be pronounced the cheaper. 2. What SUPPLEMENTS or books would furnish me with information about compressed air? A. See SUPPLEMENT, Nos. 799, 857, 893, 510, 786, 900. Also SUPPLEMENT catalogue, sent by mail. 3. Why is compressed air not more used for street car propulsion? A. It is too expensive and cumbersome. See SUPPLEMENT, Nos. 176, 177, 182, 553, 637, 747, 845, 866, 890, 903, 904.

(6026) H. R. C. asks: 1. Does the induction coil increase both the tension and quantity of current or just the tension alone? A. The regular induction coil increases the tension and lowers the current strength. It also produces a sort of alternating current. 2. I used common table salt in place of sulphur of copper in making a gravity cell. When I connect a small motor in the circuit it runs very rapidly at first and then stops. What is the cause? A. The cell rapidly polarizes, the combination is in every way a very poor one. 3. How can the Leyden jar be charged with a gravity cell? A. Connect the knob to one pole and the outer coating to the other. The charge will be so minute as to be appreciable only by very delicate instruments. 4. Why are the magnetic poles continually changing? A. The reason is unknown.

(6027) C. L. writes: I have three storage batteries, and I would like to get some idea of what power I can get from them if attached to a proper motor. Each cell has 14 plates (7 to each pole), 6¼×9 inches (measured only the part that was supposed to be in the solution), making a total of 42 plates in the three cells. Can such cells be arranged to give small power for long time or large power for short time? A. Your battery will give about 18 amperes and 6 volts or 54 amperes and 2 volts, according to connection. The series connection (18 amp. 6 volts) is preferable. This gives $\frac{108}{746}$ horse power. The cells can be used from this as a maximum down as low as desired, according to the motor used.

(6028) F. C. H. writes: We are putting in a steam heating plant in a large hospital. The boilers, five in number, must be situated on practically the same level as the building to be heated, unless an excavation at least 18 feet deep and 40×60 is made for them. Is the gravity system of such advantage that you would advise this excavation, at an enormous expense, or would it be better to have the return water conducted into a receiver with automatic pump attached, so that the water could be delivered into the boilers? A. The sinking of the boilers in an excavation for the convenience of a return system is not desirable, in view of the well known appliances of the present day for returning the water of condensation to the boilers. A small cellar with tank and automatic pump, below the line of return pipes, is the cheapest and most satisfactory system. 2. In ventilating a large hospital would it be better to propel by fans warm air into the rooms through registers placed near the ceiling, expecting this pressure of air, assisted by the steam heated ventilating stacks, to force the foul air out through shafts near the mop board of each room, or would it be best to permit the hot air to escape through the heated basement corridor through registers placed near the ceiling, and connect fans with foul air ducts, drawing the foul air out of the room through registers near the floor, this draught to cause the hot air to circulate rapidly through the room, warm it and pass out through the foul air ducts, the latter plan being the reverse of the former? A. The plenum or pressure system similar to the first named gives the most satisfactory results for both winter and summer ventilation. It partially counteracts unequal heating on different sides of the building from outside wind pressure. It prevents indraughts from the windows by the draught of the fan in the other system. The heating and ventilation of a hospital for the insane is too important a matter for a general categorical answer. The plans should be passed upon by an expert in heating and ventilating such buildings. 3. Can you give me the colors used in making different colored sidewalk tile out of a mixture of Portland cement and sand? A. Venetian red, black oxide of manganese, and chrome yellow are the principal coloring matters of cement walks.

(6029) W. L. B. asks: In that class of rheostats where change of resistance is caused by change of pressure on a carbon powder, is lampblack suitable for the powder? If not, where could I obtain carbon powder that would be? A. We advise you to use powdered battery or electric light carbon. If the latter, see that the copper plating is dissolved before powdering. Lampblack would give very high resistance.

(6030) W. W. P. asks: 1. What would be the effect if I were to wind a flat iron ring with a continuous winding instead of alternating them, and place it in the fields of the Morday alternatingmachine? Would I receive a great deal of current with low voltage, *i. e.*, direct current? A. This might be done with a proper commutator and connections. It is not advisable. 2. How many watts do you require for one man power? A. 746 watts=1 horse power, or 93 (about)=1 man power. 3. I wish to produce Tesla currents. What is the simplest way for reproducing some of his experiments on a small scale? A. There is no simple way. We refer you to Tesla on "Alternating Currents," $1, and Tesla's "Inventions, Researches and Writing," just published, $4 by mail.

(6031) C. A. D. asks: Can you inform me the degree of heat necessary to transform limestone from its natural state into lime? And what length of time is required to complete the process in an ordinary furnace? Does it require a gradual heat, or would a blast furnace expedite the process? A. 36 to 48 hours may be needed to burn a kiln of lime, and a white heat is attained in the process. The carbon of the fuel acts to facilitate the operation by its reducing action. Gradual heating is not needed.

(6032) Reader writes: A says that a black overcoat is warmer than a light colored one of equal weight, because the dark colored cloth absorbs the rays of light, while the light colored reflects them. B gives reasons which are almost identical for saying that the light colored coat is the warmer. Which is right? A. In general terms the black coat would be warmer in the sun—the white one in the shade or at night.

(6033) M. M. asks: What is the ratio of the volume of high pressure cylinder to that of the intermediate pressure cylinder in a triple expansion engine, also the ratio of the intermediate to the low pressure cylinder? Also, what are the cylinders' diameter and stroke of the largest triple expansion engine? A. The ratio of the volumes of the cylinders of triple expansion engines varies somewhat with different makers, and to meet the requirements of expansion for steam at various pressures, as well also the capacity of a receiver, if one is used. The usual practice for marine engines is for steam at 100 to 130 pounds pressure 1, 2·25, 5, and for 150 pounds pressure 1, 2·55, 6·90 as the relative volumes of the three cylinders. The cylinder diameters of one of our largest ocean steamers having two engines of 10,000 horse power each are 45, 71, and 113 inches with 60 inch stroke.

(6034) Inquirer, Newfoundland, asks: 1. Would an ordinary kerosene lamp, with a sheet iron drum placed just upon its chimney so that the heat from it may radiate slowly through the apartment, heat the apartment better than the lamp without the above attachment? A. The absolute heating power of a lamp will not be increased by the absorption by and radiation of a metal drum through which the heat passes, but the action of low radiant heat from such a source seems in some way to modify the susceptibility of the nerves to the sense of heat, and in that way appears to increase it. 2. Would the comparative heating value be the same whether the room had a chimney or not? A. The effect of a chimney opening into a room is to carry off heat, and may only be considered as a ventilator. 3. In case of feather bed on which a person with mild form of scarlet fever (scarlatina) lay till recovery, would it be sufficient disinfection to fumigate once or twice with good disinfectant, for three or four hours at a time, and then put bed in open air; or would it be necessary to take feathers out of tick, and wash case and feathers? Please state best way to disinfect in above case. A. The method of disinfecting as described may be proper and safe, if disinfectants such as carbolate of camphor or other approved methods are applied to the inside of the mattress and a quarter pound of camphor left among the feathers for a season. Such a bed should not be used by other children under six months. The safest way where there are other children is to disinfect and thoroughly wash everything appertaining to bedding and clothing.

(6035) P. S., N. O., asks: What horse power will a gasoline engine having two cylinders 4¼×6 inches stroke give at 350 revolutions? What speed will above engine drive a 21 feet long, 5 feet 6 inches beam boat, propeller 18 inches, 3 blades, 4½ feet pitch? A. The two-cylinder gasolene engine will have from 5 to 7 horse power, according to the perfection of the explosive mixture of gasolene vapor and air. It will propel the boat at from 7 to 8 miles per hour. The engine will not run with the speed named when attached to the propeller. 250 revolutions will be about right for the above boat speed.

(6036) R. W. S. asks if the valve of a high speed locomotive has to be changed to a shorter throw when running at a high rate? A. The throw of the valves in all locomotives and link valve gear engines is controlled by the link motion. The movement of the link from the dead point out in either direction controls the cut-off of the valve from 0 to the largest opening that is allowed by the construction, the amount of cut-off being generally designated by the check notches on the clamp arc.

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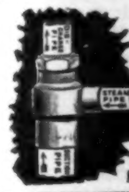

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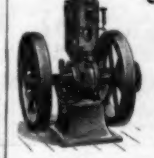

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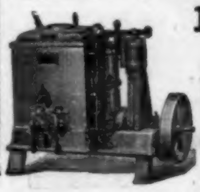

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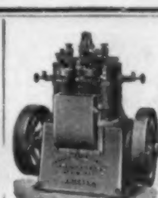

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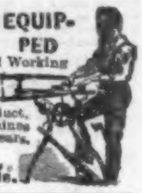

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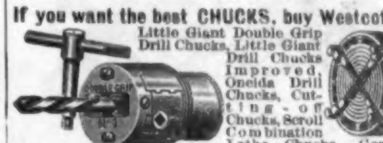

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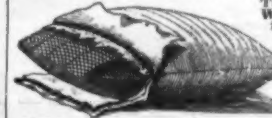

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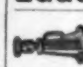

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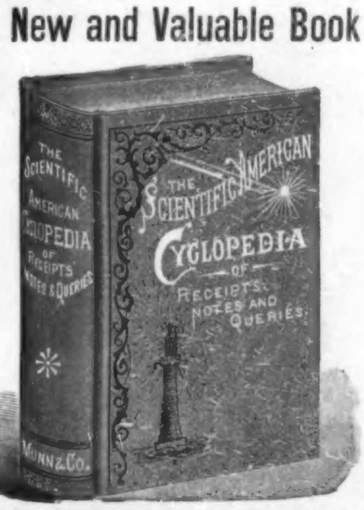

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